PROCEEDINGS OF THE AMERICAN SOCIETY OF ZOÖLOGISTS

The American Society of Zoölogists held its Twentieth Annual Meeting at the Massachusetts Institute of Technology in conjunction with Section F of the American Association and in association with other biological societies, particularly the Botanical Society of America, Ecological Society of America and the American Society of Naturalists, December 27, 28 and 29, 1922.

The officers for the year were:

President: HARRIS H. WILDER.
Vice-President: BENNET M. ALLEN.
Secretary: W. C. ALLEE.
Treasurer: DAVID H. TENNENT.
Chairman, Genetics Section: HERBERT S. JENNINGS.
Secretary, Genetics Section: LEON J. COLE.
Local Committee: R. P. BIGELOW, *Chairman*, G. H. PARKER, H. W. RAND AND H. V. NEAL.
Executive Committee: M. M. METCALF, GEORGE LEFEVRE, C. M. CHILD, GILMAN A. DREW AND CHARLES A. KOFOID.

Representatives of the Society in the Division of Biology and Agriculture of the National Research Council

	Term expires
H. S. JENNINGS	1925
WILLIAM PATTEN	1924
F. R. LILLIE	1923

Membership of the Council of the A.A.A.S.

CHARLES ZELENY
HENRY E. CRAMPTON

EDITORIAL BOARD OF THE JOURNAL OF MORPHOLOGY

Managing Editor (Term expires 1926).....C. E. MCCLUNG

THE ANATOMICAL RECORD, VOL. 24, NO. 6
JANUARY, 1923

Associate Editors

To serve until 1923 ..... { E. G. Conklin, M. F. Guyer, W. M. Wheeler

To serve until 1924 ..... { C. A. Kofoid, F. R. Lillie, J. T. Patterson

To serve until 1925 ..... { L. L. Woodruff, G. A. Drew, H. V. Neal

The Nominating Committee (Art. III, Sec. 6), composed of H. V. Neal, H. H. Newman, and Helen Dean King, reported the following nominations:

President: M. F. Guyer.
Vice-President: R. A. Budington.
Member Executive Committee: H. H. Wilder.
Member National Research Council: E. G. Conklin.
Associate Editors of the Journal of Morphology: H. V. Wilson, D. H. Tennent, and Caswell Grave.
Membership in the Council, A. A. A. S.: Charles Zeleny and H. E. Crampton.

Nominations from the floor were called for, but none being presented these officers were unanimously elected.

The resignation of D. H. Tennent as Treasurer of the Society was referred to the Executive Committee with instructions to attempt to secure clerical assistance such that Dr. Tennent might continue in office or otherwise to appoint his successor.

The Executive Committee reported the nomination of the retiring vice-president, B. M. Allen and S. O. Mast to serve on the committee on cooperation with the National Research Council. They were duly elected. This committee is now composed of the following members: F. R. Lillie (chairman) and Wm. E. Castle, who serves one more year; C. A. Kofoid and D. H. Tennent, who serve two more years; A. A. Treadwell and A. A. Schaeffer, who serve three more years, and the newly elected members who will serve four years.

The following zoölogists, having been duly nominated, were recommended for membership in the Society by the Executive Committee as having shown sufficient evidence to warrant the belief that they would continue active in zoölogical research

AGERSBORG, HELMAR PARELI VON WOLD KJERSCHOW, S.B., S.M. (Washington), A.M. (Columbia), Instructor in Zoölogy, *University of Nebraska, Lincoln, Nebraska.*

BEHRE, ELINOR HELENE, A.B. (Radcliffe), Ph.D. (Chicago), Assistant Professor of Zoölogy, Louisiana State University, *Box 70, University Station, Baton Rouge. La.*

BUCHANAN, JAMES WILLIAM, B.S. (Ohio), Ph.D. (Chicago), Instructor in Biology, Yale University. *778 Orange St., New Haven, Conn.*

CHIDESTER, FLOYD EARLE, Ph.B. (Syracuse), Ph.D. (Clark), Associate Professor of Zoölogy, *West Virginia University, Morgantown, W. Va.*

COLLINS, HENRY HOMER, A.B. (Rochester Normal), S.B., A.M., Ph.D. (California), Assistant Professor of Biology, University of Pittsburgh, *144 De Soto St., Pittsburgh, Pa.*

DUNN, EMMETT REID, A.B., A.M. (Haverford), Ph.D. (Harvard), Assistant Professor of Zoölogy, *Smith College, Northampton, Mass.*

FAUST, ERNEST CARROLL, Ph.D. (Illinois), Associate in Parasitology, Union Medical College, Peking, China. *Address 1923–1924, School of Hygiene and Public Health, Johns Hopkins University.*

HIGGINS, GEORGE MARSH, S.B. (Knox), A.M., Ph.D. (Illinois), Assistant Professor of Biology, Knox College, *65 W. North St., Galesburg, Ill.*

HYMAN, ORREN WILLIAMS, A.B., A.M. (North Carolina), Ph.D. (Princeton), Professor of Histology and Embryology, College of Medicine, University of Tennessee, *College of Medicine, Memphis, Tenn.*

NICHOLAS, JOHN SPANGLER, S.B., S.M. (Gettysburg), Ph.D. (Yale), Assistant Professor of Anatomy, *University of Pittsburgh, Pittsburgh, Penna.*

NOBLE, GLADWYN KINGSLEY, A.B. (Harvard), Ph.D. (Columbia), Associate Curator in charge of Herpetology, American Museum of Natural History, *77th St. and Central Park West, New York City.*

PLOUGH, HAROLD HENRY, A.B. (Amherst), Ph.D. (Columbia), Associate Professor of Zoölogy, *Amherst College, Amherst, Mass.*

RILEY, CHARLES F. C., A.B. (Doane), S.B. (Michigan), A.M. (Nebraska), Assistant Professor of Zoölogy, *University of Manitoba, Winnipeg, Manitoba.*

SPEIDEL, CARL CASKEY, Ph.B. (LaFayette), Ph.D. (Princeton), Associate Professor of Anatomy, *University of Virginia, University, Va.*

STRONG, LEONELL C., B.S. (Allegheny), Ph.D. (Columbia), Associate Professor of Biology, St. Stephens College, *Annandale-on-Hudson,* New York.

WALTON, ARTHUR CALVIN, B.A., M.A. (Northwestern), Professor of Zoölogy (on leave), North-Western College, *906 S. First St., Champaign, Illinois.*

WEINSTEIN, ALEXANDER, B.S., Ph.D. (Columbia), Johnston Scholar, Johns Hopkins University, *Biological Laboratory, Johns Hopkins University, Baltimore, Md.*

WHEELER, GEORGE CARLOS, B.A. (Rice Institute), M.Sc., D.Sc. (Harvard), Instructor in Entomology, *Department of Zoölogy, Syracuse University, Syracuse, New York.*

WILLIER, BENJAMIN HARRISON, B.S. (Wooster), Ph.D. (Chicago), Instructor in Zoölogy, *Department of Zoölogy, University of Chicago, Ill.*

The following former members were reinstated:

COKER, R(OBERT) E(RVIN), B.S., M.S. (North Carolina), Ph.D. (Hopkins), Professor of Zoölogy, University of North Carolina, *Chapel Hill, N. C.*

GRIGGS, LELAND, A.B., Ph.D. (Dartmouth), Professor of Biology, Dartmouth College, *Hanover, N. H.*

UNION OF BIOLOGICAL SOCIETIES

The proposed federation of biological societies was approved and, on nomination by the Executive Committee, F. R. Lillie and W. C. Allee were appointed to represent the Society on the council of the new organization. In order to avoid confusion this federation will be known as the Union of American Biological Societies.

TREASURER'S REPORT

The report of the Treasurer for the year 1922 was examined and approved by the auditing committee, W. H. Longley and A. A. Schaeffer, and was accepted and ordered placed on file by the Society. The report follows:

Report of Treasurer of the American Society of Zoölogists for the Year 1922

Balance on hand last report, Dec. 26, 1921	$ 908.09
Additional receipts by Treasurer Allee between date of report and date of remittance to new Treasurer	102.85
	$1,010.94
Additional expenditures by Treasurer Allee	6.20
Balance forwarded to D. H. Tennent, Jan. 15, 1922	1,004.74
Receipts Jan. 15 to Dec. 19, 1922	2,327.53
Total cash handled during 1922	3,332.27
Expenditures Jan. 15 to Dec. 19, 1922	2,488.15
Balance on hand, Dec. 19, 1922	$ 844.12
The funds of the Society are deposited with the Bryn Mawr Trust Co., Bryn Mawr, Pa.	
Savings Account	$ 711.65
Checking Account	132.47
Total	$ 844.12

ANALYSIS OF REPORT OF TREASURER

Receipts

Received from W. C. Allee, Jan. 15, 1922			$1,004.74
Back dues received			
1 at $ 2.00	$ 2.00		
3 at 5.00	15.00		
11 at 7.00	77.00		
2 at 11.50	23.00		
Total	$ 117.00	$ 117.00	
Dues current year received:			
71 at $ 5.00	$ 355.00		
212 at 7.00	1,484.00		
28 at 11.50	322.00		
Total	$2,161.00	2,161.00	
Dues of Irregular Amount		7.00	
Refund for Overpaid Subscriptions		6.00	
Dues for 1923 and 1924 paid in advance		21.50	
Interest Credited		15.03	
Total Income 1922		$2,327.53	2,327.53
Total cash handled			$3,332.27
Total expenditures			2,488.15
Balance			$ 844.12

Expenditures

Paid for Current Expenses of Secretary:			
Expenses Secretary at Toronto,		$ 39.05	
" " Typewriting		9.30	
" " Jan.–March		23.66	
" " Printing (Wistar)		64.61	
Total for Secretary		$ 136.62	$ 136.62
Paid S. I. Kornhauser, as voted by Society in aid of work on dyes			25.00
Paid L. J. Cole, share of A.S.Z. for printing in connection with Genetics.			22.75
Paid A. O. Weese, Ecological Society of America, charge against appropriation voted by A.S.Z.			12.70
Expenses Treasurer, Postage,			10.60
Refunded for overpaid dues			4.50

Paid Wistar Institute, Subscriptions:

Feb. 25....	$ 210.50			$1,748.50	
Mar. 8....	291.00		May 8....	118.00	
" 10....	296.50		June 15....	122.50	
" 15....	262.50		" 27....	37.00	
" 20....	196.00		Aug. 7....	45.50	
" 25....	216.00		Sept. 25....	44.00	
April 5....	160.00		Oct. 14....	67.50	
" 17....	116.00		Nov. 9....	37.00	
			Dec. 18....	55.00	
	$1,748.50			$2,275.00	$2,275.00

Exchange on foreign checks	.98
Total Expenditures	$2,488.15

The actual income of the Society during the year 1922 has been:

From 16 payments of back dues at .50	$ 8.00
From 311 payments of current dues at .50	155.50
Interest on deposits to June 30	14.59
Interest accrued but not yet credited	14.66
Total	$ 192.75

The expenses of the Society have been:

Secretary's office	$ 136.62
Grant to S. I. Kornhauser	25.00
L. J. Cole, Genetics	22.75
Grant, Ecological Society	12.70
Treasurer's office	10.60
Total	$ 207.67

To this amount should be added $33.50 paid to The Wistar Institute by order of the Executive Committee in cancellation of the bad debts of two members of the Society who were dropped for non-payment of dues.... $ 33.50

Actual Expenditures	241.17
Actual Income	192.31
Excess of expenditures above income	$ 48.86

This amount (loss) will be increased when total expenditures of Secretary and of Treasurer are paid.

Three ex-members (in addition to the two mentioned above) dropped for non-payment of dues, each in arrears for the years 1919–20–21, owe the Society a total of $63.00; three members in arrears for 1921 and 1922 owe a total of $38.00; 28 members in arrears for 1922 only, owe a total of $188.50; this making a grand total of $289.50.

D. H. TENNANT, Treasurer.

December 19, 1922.

The Secretary reported that President Wilder had appointed H. S. Pratt to represent the Society in the matter of the Spencer Fullerton Baird Memorial.

E. F. Adolph, also appointed by President Wilder, represented the Society at the Conference on World Metric Standardization which was held at Pittsburgh in September under the auspices of the American Chemical Society, submitted the following report:

It appears that organized opposition to the popular use of the metric system in this country has arisen. It was not the purpose of this Conference to oppose this, but to act in encouraging and crystallizing the influence of scientists in this matter. There was no discussion upon the use of legal means in attaining the spread of the metric system. All those present were in favor of a very gradual adoption of the system, through the agency of educational institutions chiefly. Commercial institutions can not be influenced in any wholesale fashion, but the system of double marking which is already widespread should be encouraged. Four resolutions embodying these sentiments were adopted.

The report of the secretary of the Conference, Professor W. V. Bingham of Carnegie Institute of Technology, has been published in *Science*, vol. 56, page 362, September 29, 1922.

REPORT OF COMMITTEE ON BIOLOGICAL STAINS.

To the Members of the Society of American Zoologists:

Your representative on the Committee on Biological Stains wishes to report the following progress:

Sixteen members of the society agreed to carry on tests to compare American made dyes for microscopical purposes with European products. Seven basic dyes and five acid dyes were selected for these tests, it being the aim to include only those dyes most essential for general laboratory work. Mr. R. T. Will of Rochester and your representative then mailed out 203 samples to the following collaborators:

Ezra Allen,	Ursinus College	Bordeaux Red	7
		Acid Fuchsin	6
L. B. Arey,	Northwestern Univ.	Haematoxyline	3
		Eosin	7
Gary N. Calkins,	Columbia University	Methyl Green	7
F. W. Carpenter,	Trinity College	Methylene Blue	16
Ulric Dahlgren,	Princeton Univ.	Haematoxylin	3
		Orange G	6
H. S. Davis,	Univ. of Florida	Bordeaux Red	6
Robert Hance,	North Dakota Agri. College	Haematoxylin	3
		Eosin	7
R. W. Hegner,	Johns Hopkins Univ.	Methyl Green	6
		Eosin	7

Davenport Hooker,	Univ. of Pittsburgh	Methylene Blue	8
		Eosin	5
S. I. Kornhauser,	University of Louisville	Haematoxylin	3
		Orange G	7
		Safranin	7
C. E. McClung,	Univ. of Pennsylvania	Safranin	8
		Haematoxylin	2
		Orange G	7
G. H. Parker	Harvard University	Mythelene Blue	26
F. P. Reagen,	Univ. of California	Haematoxyline	3
		Eosin	7
W. R. B. Robertson,	Univ. of Kansas	Haematoxylin	3
		Orange G	6
George L. Streeter,	Johns Hopkins Univ.	Carmine	4
		Cochineal	2
		Carmine Acid	2
H. B. Ward,	Univ. of Illinois	Eosin	10
		Congo Red	7
		Orange G	2

Each sample of the test stains was given a number according to its manufacture or source: thus no. 250 stood for Grübler, no. 223 Coleman and Bell, no. 123 National Aniline and Chemical Company, etc. No investigator except your representative was informed as to the source of the dyes he tested. In each case when obtainable Grübler's dyes were included and many of the collaborators included in their tests as checks Grübler stains which they had in their own laboratories, and with which they were familiar.

Thirteen collaborators have sent in their final reports to Chairman H. J. Conn and myself. These thirteen reports cover all the kinds of stains sent out. The reports in general are very satisfactory and show that in many instances American dyes are superior to those formerly used. Thus no. 250 is often far down in the list arranged according to desirability.

American C. P. Haematoxylin has proved entirely satisfactory. Domestic Methylene blue for blood stains, for tissues, and for intra vitam work of the most delicate sort has proved its worth. The results on carmine and its allied stains were good. In regard to safranin and methyl green, opinions differ, there being one favorable and one unfavorable report for each. Of the acid dyes good American products of all types tested have been found. In regard to Orange G, the American dye is often far more concentrated than that formerly used and tends to overstain in alcoholic solutions.

Inasmuch as the work of the Committee on Biological Stains operated under the National Research Council and obtained its funds through the agency of the Research Council and since the Council did not wish to pass judgment on commercial products, the committee together with the majority of collaborators has formed a new organization independent of Research Council, a commission to certify biological stains. Dr. H. T. Conn has been the prime mover of this arrangement.

It is planned to draw up specifications for the various dyes, to test samples submitted and to sell the producer or bottler of the dye labels certifying the contents.

The coöperation of the members of our Society in this work has been splendid and their detailed results are available to any who may chance to use them.

Respectfully submitted,

(Signed) S. I. KORNHAUSER.

The report was discussed at length. Dissatisfaction was expressed over the proposal to sell certification certificates to producers, and the attention of the Society was called to the possibility of legal complications growing out of the publication of decisions of the committee which might tend to force firms out of business. The whole question was referred to the Executive Committee with power.

Resolutions

The committee on resolutions consisting of H. S. Pratt, Alice Boring and C. E. McClung presented their report which was adopted by a standing vote and ordered spread on the records of the Society.

The SOCIETY OF ZOOLOGISTS desires to record in the following minutes its recognition of the services to science and to humanity of the members who have died during the past year:

JAMES VISCOUNT BRYCE

In the selection of honorary members the American Society of Zoölogists has been most conservative but in electing Lord Bryce as the first of this group, it set a worthy standard. It is not necessary here to make record of the well known achievements of this great man, but it is well to remind ourselves of the great value of the scientific method of the study of human relationships, so well exemplified by him in his masterly historical studies. His example should be an inspiration to all who would make the methods and principles of science generally effective in social relations.

The American Society of Zoölogists desires to make formal record of the profound respect in which the character and achievements of Lord Bryce are held by its members, and to express the great sense of loss which is felt in his passing.

ALFRED GOLDSBOROUGH MAYOR

1868-1922

Dr. Mayor was one of the most brilliant and versatile American men of science. A keen, analytical and finely trained mind, great industry, and a high courage which led him to undertake any matter he was interested in without regard to the obstacles or dangers involved, enabled him to produce scientific work of enduring value, and

also, as Director of the Department of Marine Biology of the Carnegie Institution of Washington, to put many other investigators in the way to do the same. A refined and artistic temperament, a knowledge of books and a wide experience of men and affairs, an appreciation of what is fine and beautiful in life and the world, and a fund of good nature, made him a friend and companion almost beyond compare. He was a unique personality, and his death has left a gap in our world of science which cannot be filled; we shall not see his like again.

CAROLINE BURLING THOMPSON
1869–1921

In spite of much ill health Dr. Thompson achieved the all too unusual result of being both a productive scholar and an inspiring teacher. Her work on the Termites has placed the origin of the castes of these forms on a new and sound basis. This work was pursued in the midst of hours of teaching with a steadfastness of purpose which was, along with her ever stimulating personality, one of the characteristics by which she will long remain in the minds of her students and scientific colleagues; to them her example will not cease to be a stimulus and an incentive.

ALICE ROBERTSON

It was not only through her many investigations on the Bryoza, by which she is widely known, but through the embodiment in her of the spirit of the scholar and the scientist, that Dr. Robertson made her influence felt. Though research was her life, hers was a many-sided mind, bringing to the study of political events and of literature the same keen interest and understanding which was manifest in her special field; and to all this was added the human kindliness, that ever-ready Scotch wit, and her joy of life, that drew to her such a host of friends.

Changes in the Constitution and By-Laws

The Constitution of the Society was amended to allow the election of associate members from the workers in zoölogy who do not satisfy the research requirements for full membership. The By-Laws were changed to provide, first, that the annual dues from such associate members would be the same as for full members and, second, that such associate members might become members of sections of the Society and are entitled to the journal privileges of members. The By-Laws as amended do not extend the program privileges of the Society to associate members unless they are introduced by members. The Constitution and By-Laws as amended are published in another section of the Proceedings.

REPORT OF THE COMMITTEE ON PUBLICATION, AMERICAN SOCIETY OF ZOOLOGISTS, 1922

By vote of this society in 1919 the three incoming associate editors of the Journal of Morphology constitute a Consulting Committee, whose function it is to assist in maintaining a spirit of helpful cooperation between the Society of Zoölogists and The Wistar Institute, and to consider problems relating to the publication of research in zoölogy.

Your committee reports that as a result of the increase in numbers of papers presented for publication in the Wistar journals since the Great War, affairs have reached a crisis like that which forced the Society in 1916 to increase its annual dues to $6.50. The fact is that the funds available for the publication of researches in zoölogy have long been inadequate to meet the demand. The attempt of the management of the Wistar to meet this emergency in 1921 resulted in a deficit of $11,406.65 or more than one quarter of the total income of the Institute. With the income at present available it is possible to publish less than half of the papers presented for publication. This presents a serious problem since the prompt publication of the results of research is of vital importance to every active zoölogist. Some solution of the problem presented in this accumulation of unpublished material is urgently needed. Matters cannot be permitted to continue as at present.

It may not be fairly said that this is a problem for the Wistar to solve and not a problem of our Society. The assumption of the burden of publication by the Wistar has meant much in the way of opportunities for the publication of our researches, but it does not mean the assumption of the entire burden of financial responsibility. The Wistar is under no obligations whatever to subsidize zoölogical research.

During the fourteen years since the Wistar undertook the publication of the Biological journals the publication of the researches of American zoölogists has been continuous and stable to a degree previously unknown. The Wistar has consistently met the essential requirements for 'prompt publication in adequate form with the widest possible distribution to those interested in the results of zoölogical research.' In this period the subscription lists of the Wistar journals have risen from 1,410 to 5,286 in 1920, and the cost has increased from $12,568.34 to $46,005.25. The number of pages published annually has trebled. A marked improvement in the condition of manuscripts received for publication with consequent decrease in cost of corrections has followed the educational campaign carried on by the Wistar. The admirable bibliographic service has been added to the publication of the abstracts of the papers presented at the annual meetings. The great service performed by the Wistar Institute and its efficiency as a publication office are too well known to require emphasis at this time. But not even the Wistar can be expected to continue to subsidize the publications of the zoölogists of this country to the amount of $11,000 annually.

In 1913 a Committee was appointed by this Society to raise funds for the publication of zoölogical research and for the support of the Wistar journals. But the outbreak of the Great War prevented the committee from accomplishing its purpose. The financial emergency was temporarily met in 1916 by the increase of the Society dues to $6.50. For this sum—that is, for a sum less than the actual cost of publi-

cation—each member of this Society has received journals whose subscription price amounts to over fifty dollars. What this has meant is better appreciated when we remember that the many members of the American Chemical Society pay annual dues of $15.00 and receive only three journals including the Chemical Abstracts, and the members of the British Chemical Society for an annual fee of sixteen dollars receive only a single journal.

The publication problem which confronts us is fundamentally a financial problem since the congestion of unpublished matter can be relieved only by funds adequate for its publication. The system of fixed annual dues of this society does not permit the necessary increase in the amount of material published annually. The Wistar has been subsidizing the publication of research to the extent of several thousand dollars annually. Since we may not expect the Wistar to finance increasing deficits indefinitely, we must make up our minds as to what we intend to do.

Various suggestions have been made looking to the solution of our problem:—

1. It has been suggested that instead of receiving a group of journals each member be allowed the privilege of purchasing any of the Wistar publications for 50 per cent. of the established price.

2. Some urge further increase in the annual dues as a temporary expedient as in 1916. The Director of the Wistar estimates that in order to continue the present arrangement whereby members receive a group of journals and to permit an increase in the amount of material published annually it would be necessary to increase the annual dues to $16.00.

3. Others recommend the appointment of a Committee to raise endowment for the publication of research.

4. Some believe that the financial problem could be solved by requiring authors or the institutions with which they are connected to share the cost of publication. In this way increase in revenue would accompany increase in material published.

5. Several suggestions looking towards greater economy in publication, but they do not appear to meet the fundamental difficulty. Some recommend a stricter limitation in the length of papers, or a more rigorous editorial policy, the limitation of publication privileges to members of this Society, the elimination of plates except when the author pays for them, and the substitution of the bibliographic cards in the place of the abstracts of papers, etc. Such suggestions are obviously not mutually exclusive and might all be tried. While commendable they do not appear adequate to meet the present emergency.

6. Finally there is Dr. Crozier's plan of radical changes in the methods of publication involving

a. The discontinuance of the grouping of papers in the numbers of a journal.
b. The immediate publication of each accepted paper as a "separate."
c. The discontinuance of the author's privilege of purchasing reprints at cost.
d. The sale of individual papers at prices as near the cost of publication as possible.

Whatever the advantages—or disadvantages—of this plan, the Committee believes it to be illusory as a device for meeting the financial problem of increased amount of publication. Indeed it is the conviction of the committee that hasty action of any sort should not be taken. The problem must be carefully considered in all its aspects and decision reached only after it is certain that we shall not leap

from the frying pan to the fire. The need for immediate consideration is, however, so great that the Committee recommends that the President appoint a committee on publication with power to take whatever action seems necessary. This committee should confer with a similar committee of the Anatomists and of the Union of Biological Societies in case such a Union is formed.

Signed
GILMAN A. DREW,
L. L. WOODRUFF,
H. V. NEAL.

After some discussion, which included a statement from Dr. Greenman concerning the point of view of The Wistar Institute, the following resolution was adopted addressed to the Editorial Board of the *Journal of Morphology* and to The Wistar Institute:

Resolved: That the American Society of Zoölogists favors a policy of condensation of papers, including those already in hand, until the present congestion in printing of research results be relieved and that preference in publication be given with reference to condensation.

On motion of the Executive Committee, the Society appointed a Publication Committee consisting of C. E. McClung, Chairman, F. R. Lillie, Caswell Grave, H. V. Wilson and D. H. Tennent and gave them power to make all temporary arrangements and negotiations necessary to continue publication up to the point of final commitment of the Society to new policies.

The thanks of the Society were voted to the local committee, R. P. Bigelow, G. H. Parker, H. V. Neal and H. W. Rand, in appreciation of their work in arranging for the meeting.

Minutes of Genetics Sections

Sessions for the reading of papers were held Wednesday morning and Thursday morning and afternoon. In the absence of the chairman, Dr. H. S. Jennings, at the first session, Dr. C. B. Davenport was elected to preside. In addition to the reading of scheduled papers, the only business transacted was the appointment of a committee to nominate officers for the ensuing year Dr. Jennings presided on Thursday. At a short business session during the afternoon the following officers were nominated and elected:

Chairman—E. M. East.
Secretary—D. F. Jones.
Representatives of the Zöologists—J. H. Gerould.
Representative on the Board of Control of Botanical Abstracts—Sewall Wright.

The secretary presented three recommendations from the Executive Committee, which were adopted:

1. Papers placed on the program shall be limited to a maximum of 15 minutes, except by special vote of the Executive Committee.
2. The final date for the reception of titles for the program shall be determined by the secretary and may be independent of the time set by the other sections of the parent societies. Titles, to be accepted, must be accompanied by abstracts of not to exceed 250 words in length.
3. In the absence of the author, papers on the program shall be read by title only, except by special vote of the members of the Sections present at the meeting.

The necessity of having small dues to meet the ordinary expenses of the Sections was presented by the secretary and it was

Moved: That annual dues of fifty cents per member be assessed for this purpose, the manner of its collection to be determined by the secretary in consulting with the officers of the parent Societies. Carried.

The question was raised as to whether the traveling expenses of the secretary in attending the annual meeting should be paid from the funds thus raised and the chairman ruled that such was the intent of the motion, to take effect the coming year.

The average attendance at the meetings was about 120.

Leon J. Cole,
Secretary of Genetics Sections.

PROGRAM

Wednesday Morning Session, December 27

10:00 A.M. This session was held in three sections:

I. Papers on Parasitology and on Cytology and Histology; twelve papers were read in full and eleven by title. Attendance 75–100.

II. Miscellaneous papers; four papers were presented in full. Attendance 25–50.

III. Joint Genetics Sections of Botanists and Zoölogists; twelve papers on animal genetics were presented in full and two were read by title.

Wednesday Afternoon Session

2:00 P.M. Papers on Embryology and Comparative Anatomy; thirteen papers were presented in full and three by title. Attendance 100 or more.

Wednesday Evening

9:00 P.M. The Biological Smoker was held in the Walker Memorial Building. About 500 present.

Thursday Morning Session, December 28

9:30 A.M. This session was held in two sections:

I. Remaining papers on Comparative Anatomy and those on Entomology and those on General Physiology (in part); ten papers were read in full and eleven were read by title.

II. Joint Genetics Sections: thirteen papers were read and three were presented by title. Attendance 100 or more.

Thurdsay Afternoon Session

2:00 P.M. I. General Physiology concluded with eleven papers read in full and twelve by title. Attendance about 100.

II. Joint Genetics Sections; the program was concluded with 12 papers read in full and three by title.

Thursday Evening

7:00 P.M. Zoölogists' Dinner followed by the address of C. A. Kofoid, retiring President of the Society and retiring Vice-President of Section F on "The Life Cycle of the Protozoa." Attendance 140.

Friday Morning Session, December 29

9:15 A.M. Business.

10:20 A.M. Joint meeting with Ecological Society of America. Ten papers presented in full and five by title.

Friday Afternoon Session

2:00 P.M. Joint symposium with the American Society of Naturalists and the Ecological Society of America. The entire program of nine papers was presented.

At the sessions for the presentation of papers, 106 papers were presented in full and 50 were read by title. There were eight exhibits making a total of 164 separate titles on the program.

LIST OF TITLES

The following titles, contributed for the program, have been grouped and arranged in accorance with rules accepted by the Society except in the Genetics program where cooperation with the Botanical Society have caused some slight modification.

The papers marked with an asterisk were read by title only.

The titles have been numbered consecutively and the corresponding abstracts has the same number given the title. On account of complications growing in the main, out of intersociety relations, certain abstracts were received too late to be included among those originally printed. They are given here in order to present

a complete report of the proceedings of the meeting but are grouped together as "late abstracts" in order to avoid the expense of breaking paging in matter already composed.

A. PARASITOLOGY

* 1. Development of a myxosporidian, *Myxosoma catostomi* nov. spec. R. Kudo, University of Illinois.

2. *Spirochaeta eurygyrata.* M. J. Hogue, North Carolina College for Women.

3. A new liver fluke from the monkey. Horace W. Stunkard, New York University.

4. Observations on an acquired immunity to a metazoan parasite. Leslie B. Arey, Northwestern University Medical School.

* 5. Variations in *Euglenamorpha hegneri*, n.g., n.sp., from the intestine of tadpoles. D. H. Wenrich, University of Pennsylvania.

* 6. *Diphyllobothrium parvum.* Thomas Byrd Magath, Mayo Clinic.

* 7. Notes on Acanthocephala from Japan. H. J. Van Cleave, University of Illinois.

* 8. The relations between the food of frog and toad tadpoles and their intestinal protozoa. R. W. Hegner, Johns Hopkins University.

9. The use of the pure culture and the guinea pig in biological studies of parasitic nematodes. B. H. Ransom, U. S. Bureau of Animal Industry.

*10. Studies on *Necator suillus*, parasitic in pigs. James E. Ackert and Florence K. Payne, Kansas State Agricultural College.

11. The life-history and development of the mite, *Myobia musculi*, Schrank. Howard E. Enders, Purdue University.

12. The effect of carbon tetrachloride on intestinal protozoa. A preliminary note. M. J. Hogue and C. Van Winkle.

13. A new genus of trematode from the eastern painted turtle. Horace W. Stunkard, New York University.

*14. Cross-infection of muscoid flies with *Herpetomonas.* Elery R. Becker, Johns Hopkins University. (Introduced by W. H. Taliaferro.)

*15. Interactions between protoplasmic masses as a means of determining physiological variations in *Arcella.* B. D. Reynolds, Johns Hopkins University. (Introduced by R. W. Hegner.)

*16. Variations in *Taenia saginata*, the "beef" tapeworm of man. Franklin D. Barker, University of Nebraska.

*17. The chromosomes in *Ascaris lumbricoides* of man. Franklin D. Barker.

B. CYTOLOGY AND HISTOLOGY

18. Cellular elements in the perivisceral fluid of the Echinodermata. James E. Kindred, Western Reserve University.

19. The application of the Bielchowsky-Paton method to the nervous system of the earthworm. (Lantern and microscopic demonstrations.) W. M. Smallwood, Syracuse University.

*20. Lutear cells in the gonads of the Phalarope (by title). Harry B. Yocum, University of Oregon.

21. The nature of the division of neuroblastic cells in the regenerating spinal cords of Amphibian larvae. Davenport Hooker, University of Pittsburgh School of Medicine.
22. Sources of nutriment during the metamorphosis of fresh-water mussels. Leslie B. Arey, Northwestern University Medical School.
23. The typical form of polyhedral cells in plant parenchyma and in human epithelium. (Lantern and models.) Frederic T. Lewis, Harvard Medical School (introduced by Herbert W. Rand).

C. UNCLASSIFIED

24. Fiji-New Zealand expedition from the University of Iowa. (Lantern; 60 minutes.) C. C. Nutting, University of Iowa.
25. Observations of biological science in Russia. H. J. Muller, University of Texas.
26. The proper wording of titles of scientific articles. E. W. Gudger, American Museum of Natural History.
27. Variations of coat-color within a single subspecies of mice of the genus *Peromyscus*. (Lantern.) H. H. Collins, University of Pittsburgh. (Introduced by E. F. Adolph.)

D. ENTOMOLOGY

*28. Afferent and efferent pathways in *Dendroides*. William A. Hilton, Cornell University.
29. Ant larvae. (Lantern.) W. M. Wheeler, Harvard University, and G. C. Wheeler, Syracuse University.
*30. Further observations on the digestive system of the periodical Cicada. Charles W. Hargitt and L. M. Hickernell, Syracuse University.

E. EMBRYOLOGY

31. Periodicity in the production of sexual cells in marine animals. B. H. Grave, Wabash College.
32. Germ cell and germ gland development in male *Rana catesbeiana* tadpoles. (Lantern.) W. W. Swingle, Yale University.
33. The microdissection of the egg of *Cerebratulus*. George A. Baitsell, Yale University.
*34. The presence of copper in *Arbacia* eggs. Otto C. Glaser, Amherst College.
*35. Analysis and interpretation of lithium effects in echinid embryos. J. W. MacArthur, University of Toronto.
36. Cryptorchidism experimentally produced. Carl R. Moore, University of Chicago.
37. Iodine and anuran metamorphosis. (Lantern.) W. W. Swingle, Yale University.
38. Iodine and urodele metamorphosis. W. W. Swingle.
39. Experiments on metamorphosis. (Lantern.) Karl E. Mason, Yale University (Introduced by W. W. Swingle).

40. The vascularity of the enamel-organ in the developing molar of the albino rat. William H. F. Addison and J. L. Appleton, Jr., University of Pennsylvania. (Introduced by C. E. McClung.)

41. Experiments on limb posture in *Amblystoma punctatum*. J. S. Nicholas, University of Pittsburgh School of Medicine. (Introduced by R. G. Harrison.)

42.[1] The Entrance of the Spermatozoa into the Starfish Egg. Robert Chambers, Cornell University Medical College.

*43.[1] The Subdivisions of the Neural Folds in Man. G. W. Bartelmez, University of Chicago.

F. COMPARATIVE ANATOMY

44. The origin and nature of the earliest neuromuscular connections in Elasmobranch embryos. H. V. Neal, Tufts College.

45. An undescribed type of sense organ found in the larva of *Botryllus*. Caswell Grave, Washington University, and Helen Woodbridge, University of Maine.

46. The morphogenesis of spines and spine-glands in the Siluridae. H. D. Reed, Cornell University.

47. On specific characters in *Teredo*. (Lantern.) Thurlow C. Nelson, Rutgers College.

48. Intramuscular sensory endings of the small intestine, with a consideration of their central connections and probable function. F. W. Carpenter, Trinity College.

*49. Glochidial teeth and the mechanics of attachment. Leslie B. Arey, Northwestern University Medical School.

50. The gall-bladder in the cat,—its development, its functional periodicity, and its anatomical variation as recorded in twenty-five hundred specimens. Edward A. Boyden, Harvard Medical School.

51. The anatomy of an abnormal double monster (Duroc) pig. (10 min.) George W. Hunter and George M. Higgins, Knox College.

G. GENERAL PHYSIOLOGY

*52. The creeping of the larvae of the slug-moths (Cochlidiidae). W. J. Crozier, Rutgers College.

*53. Photoreceptors of *Lumbricus terrestris*. Walter N. Hess, DePauw University.

54. Hibernation in Orthoptera. I. Physiological changes during hibernation in certain Orthoptera. Joseph Hall Bodine, University of Pennsylvania.

55. Some reactions of *Alligator mississippiensis*. Albert M. Reese, West Virginia University.

*56. Quantitative observations on the digestive power in Amphibian larvae during metamorphosis. Albert Kuntz, St. Louis University School of Medicine.

*57. The effect of light on various marine invertebrates. A. G. Huntsman, Atlantic Biological Station.

*58. The axial gradients in *Corymorpha palma*. C. M. Child, University of Chicago.

[1] See late abstracts.

*59. Oxygen consumption with respect to level, size, and regeneration and electrical polarity in *Corymorpha palma*. (By title.) L. H. Hyman, University of Chicago.

*60. The manner of copulation in triclad Planarians. R. A. Budington, Oberlin College.

61. The olfactory sense of the cabbage butterfly, *Pieris rapae* Linn. Dwight E. Minnich, University of Minnesota.

*62. The stimulating efficiency of intermittent light in the drone-fly, *Eristalis tenax*. William L. Dolley, Jr., Randolph-Macon College.

63. The chemical sense of *Palaemonetes vulgaris* (Say). Manton Copeland, Bowdoin College.

*64. Sterility of animals under changed conditions. (By title.) Carl Hartman, University of Texas.

65. The attachment of oyster larvae. (Lantern.) Thurlow C. Nelson, Rutgers College.

66. The circus movements of *Limulus*. William H. Cole, Lake Forest College.

*67. Effect of thyroid feeding on the color and form of the feathers of fowls. Benjamin Horning and Harry Beal Torrey, University of Oregon.

*68. The physiological response of *Paramecium* to thyroxin. Matthew C. Riddle and Harry Beal Torrey, University of Oregon.

69. Excretion and death among amebas. A. A. Schaeffer, University of Tennessee.

70. The physiological action of excretory products. Edward F. Adolph, University of Pittsburgh.

*71. Eyes in *Volvox* and their function. S. O. Mast, Johns Hopkins University.

72. The growth of marine organisms on submerged metals. G. H. Parker, Harvard University.

*73. Relative effects on ciliary activity of anion and undissociated molecule of organic acids. J. M. D. Olmsted and J. W. MacArthur, University of Toronto.

*74. On the nervous organization of *Limax*. W. J. Crozier, Rutgers College.

*75. Concerning laws of locomotion in gasteropods. W. J. Crozier.

*76. Effect of thyroid feeding on the moulting of fowls. Benjamin Horning and Harry Beal Torrey, University of Oregon.

77. The reactions of larvae of *Vanessa antiopa* Linn. to sound. Dwight E. Minnich, University of Minnesota.

*78. The process of photic orientation in *Volvox*. S. O. Mast, Johns Hopkins University.

*79. On certain determining factors in regeneration. J. William Buchanan, Yale University. (Introduced by L. L. Woodruff.)

*80. Weight changes and oxygen consumption during long exposure to dilute anesthetics. J. William Buchanan.

*81. Amoeboid movement and coalescence of dissociated sponge cells. Paul S. Galtsoff, U. S. Bureau of Fisheries. (Introduced by W. C. Allee.)

82. Reversal of vertebrate heart beat. James Nelson Gowanloch, Wabash College. (Introduced by B. H. Grave.)

83. Observations on the ciliary action of *Scyphidia*. Ruth Jane Ball, University of Vermont. (Introduced by H. F. Perkins.)

*84. The effect of temperature upon the rate of retinal pigment migration in crustaceans. Rudolf Bennitt. (Introduced by G. H. Parker.)

85. The feeding reactions of the Ciliate, *Dileptus gigas*, with special reference to the function of the trichocysts. J. Paul Visscher, (Introduced by S. O. Mast,) Johns Hopkins University.

*86.[1] Reactions of Hydra to chloretone. William A. Kepner and D. L. Hopkins, University of Virginia.

*87.[1] Blood and nerve as controlling agents in the movements of melanophores. Leland C. Wyman. (Introduced by G. H. Parker.)

H. ECOLOGY AND ZOOGEOGRAPHY

*88. Quantitative aspects of association and of seasonal succession in an artificial environment. W. J. Crozier and E. S. Harris, Rutgers College.

89. Some myriapods of South Bass Island, Ohio. Stephen R. Williams, Miami University.

90. American Opalinidae. (Charts.) Maynard M. Metcalf.

91. The alternative color-phases of fishes. W. H. Longley, Goucher College.

*92. Further observations on the hydrogen-ion concentration of Chesapeake Bay water. R. P. Cowles, Johns Hopkins University, and A. M. Schwitalla, St. Louis University.

93. The bibliography of fishes. E. W. Gudger, American Museum of Natural History.

94. The effect of environmental conditions on the rate of development. (Lantern.) A. O. Weese, James Millikin University.

95. Studies on animal aggregations: The temperature relation with isopods. W. C. Allee, University of Chicago.

96. The tadpoles of the frogs of Okefinokee Swamp, Georgia. A. H. Wright and A. A. Wright.

97. A morphological mechanism in some instances of physico-chemical adaptation. F. H. Pike, Columbia University.

*98.[1] Caddisfly larvae of swift and standing waters. (Lantern.) G. S. Dodds, West Virginia University, F. L. Hisaw, Kansas Agricultural College.

99.[1] An octo-flagellate parasitic in trout. (Lantern; 20 min.) Emmeline Moore, New York State Conservation Commission, E. S. A.

*100.[1] Recent migrations of southerly species of fish into northern waters. (Canadian Atlantic waters.) Edward E. Prince, Commissioner of Fisheries, Canada, A. S. Z.

*101.[1] The conversion of transverse stripes into longitudinal stripes in the coloration of some larval fishes. (Charts.) Edward E. Prince, Commissioner of Fisheries, Canada.

I. GENETICS SECTIONS

102. The transmission of the polycladous character in *Sphaerocarpos Donnelii*. (Lantern; 15 min.) Charles E. Allen, University of Wisconsin.

*103. Color changes in maize pericarp and the nature of the gene. (Lantern, reflectoscope; 20 min.) William H. Eyster, University of Missouri.

[1] See late abstracts.

*104. Inheritance of a primitive sporophyte in maize. (Lantern; 5 min.) William H. Eyster, University of Missouri.

105. Notes on heritable endosperm defects in maize. (8 min.) E. W. Lindstrom, Iowa State College.

106. Eight years selection for quality of oil in soy beans. (12 min.) L. J. Cole, E. W. Lindstrom, and C. M. Woodworth.

107. The relation between chromosome number and morphological characters in wheat hybrids. (8 min.) Karl Sax, Maine Agricultural Experiment Station.

108.[1] Induction of chromosomal mutants and their recognition in *Datura*. Albert F. Blakeslee and M. E. Farnham.

109.[1] Induction of gene and chromosome mutations in *Datura* by exposure to radium rays. (Lantern.) C. Stuart Gager and A. F. Blakeslee.

110.[1] Distribution of chromosomes in tetraploid daturas. J. Belling and A. F. Blakeslee.

111. Anatomical differences between the various chromosomal mutants of *Datura*. E. W. Sinnott and A. F. Blakeslee.

112.[1] Globe mutants to normal plants in *Datura* after pollination with counted pollen. J. T. Buchholz and A. F. Blakeslee.

113.[1] Species in the genus *Rubus* and *Crataegus*. Albert E. Longley.

114.[1] On a gigantic natural hybrid of the silverweed (*Potentilla anserina*). E. C. Jeffrey.

115.[1] On the origin of the boston fern. E. C. Jeffrey.

116.[1] Further evidence of linkage with crossing over in *Oenothera*. (15 min.) George H. Shull.

*117.[1] A preliminary report on the genetics of *Clarkia elegans*. (15 min.) (Lantern.) Leonas L. Burlingame.

I′. GENETICS SECTIONS

118. Factors which determine otocephaly in guinea pigs. (Lantern; 15 min.) Sewall Wright, U. S. Department of Agriculture.

119. Persistent new color patterns in grouse locusts by mutation, and linkage, or homozygosis, with isolation. (Charts; 15 or 20 min.) Robert K. Nabours, Kansas State Agricultural College.

*120. The consequences of different degrees of interference, in the crossing-over of the hereditary genes. (15 min.) H. S. Jennings, Johns Hopkins University.

121. Coincidence of crossing-over in *Drosophila virilis*. (15 min.) Alexander Weinstein (introduced by H. S. Jennings), Johns Hopkins University.

122. Notes on the pigment cells in the eyes of *Drosophila* eye-color mutants. (15 min.) O. A. Johannsen, Cornell University.

123. Analysis of "contamination" in *Habrobracon*. (15 min.) P. W. Whiting, University of Iowa.

124. Facts indicating abnormal fertilization in *Habrobracon*. (15 min.) Anna R. Whiting and P. W. Whiting, University of Iowa.

[1] See late abstracts.

*125. The birth rate among the graduates of Allegheny College. (By title), H. R. Hunt, University of Mississippi.

126. Sex-ratios in guinea-pigs. (Lantern; 10 min.) Heman L. Ibsen and Lucella Schaumburg.

127. An environmental factor causing variation in weight at birth of guinea-pigs. (Lantern; 10 min.) Heman L. Ibsen, Kansas State Agricultural College.

128. A brief description of abnormalities observed in the descendants of X-rayed mice. (10 min.) C. C. Little, University of Maine, and H. J. Bagg, Memorial Hospital, New York.

129. Inheritance of an eye-abnormality appearing in the descendants of X-rayed mice. (10 min.) C. C. Little, University of Maine, and H. J. Bagg, Memorial Hospital, New York.

130. The inheritance of a lethal head abnormality appearing among the descendants of X-rayed mice. (10 min.) C. C. Little, University of Maine, and H. J. Bagg, Memorial Hospital, New York.

131. A report of a histological study of the eyes and gonads of mice treated with a light dosage of X-rays. (5 min.) L. H. Snyder, M. Schneider and C. C. Little.

132. The production of non-disjunction by X-rays and the hereditary transmission through untreated females of the XXY condition so produced. (15 min.) James W. Mavor, Union College.

133. The effects of X-rays on the albino rat. (15 min.) Frank Blair Hanson, Washington University.

134. The effect of alcohol fumes on three generations of rats. (20 min.) Frank Blair Hanson.

*135. Results of breeding potato beetles under changed environmental conditions. (15 min.) A. W. Bellamy, University of Chicago.

136. Inheritance of weight in poultry. (15 min.) Henry G. May, Rhode Island Agricultural Experiment Station.

137. A lethal type in mice, which may live for a few days after birth. (5 min.) J. A Detlefsen, Wistar Institute.

138. Linkage studies in mice. (Lantern; 5 min.) J. A Detlefsen, Wistar Institute.

139. The heredity of the "white hooded" albino rat. (10 min.) Dorothy R. Stewart, Washington University. (Introduced by Frank Blair Hanson.)

140. Recent studies on the relation of metabolism to sex. Oscar Riddle, Carnegie Station for Experimental Evolution.

*141. Further studies of the rate of mutation in the bar series of *Drosophila*. Charles Zeleny, University of Illinois.

142. The measurement of mutation frequency made practicable. H. J. Muller, University of Texas.

*143. Sex-linked inheritance in the teleost, *Platypoecilus maculatus* Gunth. A. W. Bellamy, The University of Chicago.

144. Further control of sex in a species of Cladocera. (17 min.) Arthur M. Banta and L. A. Brown, Station for Experimental Evolution.

145. A new mutation in *Daphnia longispina* and its inheritance. (10 min.) Arthur M. Banta.

146.[1] The translocation of a section of Chromosome-II upon Chromosome-III in *Drosophila*. C. B. Bridges. (Introduced by T. H. Morgan.)

[1] See later abstracts.

JOINT SYMPOSIUM WITH THE AMERICAN SOCIETY OF NATURALISTS AND THE ECOLOGICAL SOCIETY OF AMERICA

147. Geographical distribution of certain New England mammals. Glover M Allen.
148. Ecological aspects of bird distribution in tropical Africa. James P. Chapin.
149. Reptile distribution of East and West Indies contrasted. Thomas Barbour.
150. Distribution of the Amphibia. E. R. Dunn.
151. Andean and Transandean fishes, their nature and origin. C. H. Eigenmann.
152. Geographical distribution of land mollusks. H. A. Pilsbry.
153. Geographical distribution of the Onychophora. C. T. Brues.
154. Geographical distribution of insects. P. P. Calvert.
155. Some points in the distribution of New England echinoderms. H. L. Clark.

(These papers will be published in the *American Naturalist.*)

156. The life-cycle of the Protozoa, C. A. Kofoid, retiring President of the Society and retiring Vice-President of Section F., University of California. (To be published in *Science.*)

EXHIBITS

1. Three microscopic preparations to show the application of the Bielchowsky-Paton method to the nervous system of the earthworm. W. M. Smallwood, Syracuse University.
2. A demonstration of early stages in the establishment of neuromuscular connections. H. V. Neal, Tufts College.
3. Families of butterflies from olive-green and blue-green mutant caterpillars. John H. Gerould, Dartmouth College.
4. Reprints of recent biological studies by Russian biologists. H. J. Muller, University of Texas.
5. A living sphenedon. C. C. Nutting, University of Iowa.
6. Manuscript annotated catalog of the distribution of common invertebrates of the Woods Hole littoral. Manuscript to be deposited with the Bureau of Fisheries and carbon copies distributed by them to representative libraries. W. C. Allee, University of Chicago.
7. Specimens illustrating variation in coat-color of mice of the genus *Peromyscus.* H. H. Collins, University of Pittsburgh.
8. Nine drawings of the cilia of *Scyphidia.* Ruth Jane Ball, University of Vermont.

ABSTRACTS

A. PARASITOLOGY

1. Development of a Myxosporidian, Myxosoma Catostomi nov. spec. R. KUDO, University of Illinois.

As to the nuclear changes during the course of development of tissue-infecting Myxosporidia, observations of various authors differ greatly. In the trophozoites of Myxosoma catostomi which was found to produce a conspicuous tumor in the myotomes of a common sucker, one distinguishes two kinds of nuclei: vegetative and generative. The vegetative nucleus divides by amitosis and further forms generative nuclei by a simple division. In this latter division, the vegetative nucleus gives off a large amount of chromatin material contained in the nucleolus to the newly formed generative nucleus. The generative nucleus becomes surrounded by an island of cytoplasm and grows into a pansporoblast. Gametogony does not occur. The nucleus of the pansporoblast undergoes a heteropolar division. Two nuclei which are produced by a division of the small nucleus become the trophic nuclei of the developing pansporoblast, while the large one divides repeatedly by a primitive mitosis into twelve nuclei which ultimately construct two spores. During the divisions, the latter nuclei throw off large amount of their plasmosome from the nucleoli. This substance forms the spore membrane. Autoinfection by mature spores probably occurs.

2. Spirochaeta eurygyrata. M. J. HOGUE, North Carolina College for Women.

Spirochaeta eurygyrata was cultured from the liquid stool of a person suffering from chronic diarrhea. Two pure lines were isolated and studied. Locke-egg, ova mucoid, ox-bile salts and sodium chloride-serum water media were used for the cultivation of this organism. On all these media it has lived for over a year.

Spirochaeta eurygyrata varies in length from 4–56 microns. Both its ends are rounded. It divides by transverse division which may be equal or unequal. Iron haematoxylin, Giemsa's stain, Cross' stain and weak carbolfuchsin were used with good results. Vital stains did not color the organism. With dark field illumination cross bars were seen in dead spirochaetes but were not seen in the living active forms. Attempts to inoculate kittens by feeding them *Spirochaeta eurygyrata* were not successful. An examination was made of 212 stools from 127 patients but *Spirochaeta eurygyrata* was not present in any of them. It is considered an intestinal parasite of rather rare occurrence in this country.

3. A new liver fluke from the monkey. HORACE W. STUNKARD, New York University.

While making parasitological examinations of animals that had died in Bronx Park, New York, I discovered several trematodes in the liver of a white face sapajou monkey, Cebus apella, from British Guiana, South America. These worms belong to the subfamily Dicrocoelinae Looss, but can not be assigned to any existing genus.

A new genus Hepatotrema is erected to contain the species which is named H. cebi. Specimens are 7 to 10 mm. in length and 0.5 to 0.75 mm. in width. The oral sucker averages 0.26 mm. in diameter, the pharynx 0.1 mm. in diameter and the alimentary tract bifurcates above the genital pore. The acetabulum is about one ninth of the body length from the anterior end and averages 0.24 mm. in diameter. The genital pore is midway between the suckers and the cirrus sac extends almost to the acetabulum. The testes lie one behind the other, the caudal testis one third of the body length from the anterior end, the cephalic testis slightly anterior to it. They are lobed, about 0.75 mm. in length and 0.43 mm. in width. The ovary is lobed, slightly anterior to the middle of the body, about 0.32 mm. in diameter. The vitellaria are asymmetrical, on the left side of the body extending from the middle about one half the distance to the posterior end. The caudal half of the worm is filled with uterine coils arranged in a descending and an ascending column. Eggs numerous, 19 to 27 microns.

4. Observations on an acquired immunity to a metazoan parasite. Leslie B. Arey, Northwestern University Medical School.

Immunity to glochidial parasities (e.g., Lampsilis luteola) may be acquired by fish (e.g., black bass) in two to five or more infections.

Fish that become thoroughly immune at the second or third infection slough the attached glochidia rather promptly within forty-eight to seventy-two hours.

Fish that require four or more infections acquire an ill-defined immunity and glochidia are lost progressively over several to many days.

Light infections are practically as effective as heavy dosages in producing immunity, although there is apparently a quantitative difference when the spread is extreme. The number of infections seems to be more important than the degree.

The permanency of acquired immunity remains to be proved, yet there are miscellaneous records which indicate that it lasts at least one year.

5. Variations in Euglenamorpha hegneri, n.g., n. sp., from the intestine of Tadpoles. D. H. Wenrich, University of Pennsylvania.

This new flagellate, discovered independently by Hegner and the writer, has already been mentioned in "Science" by Hegner. The writer has found two varieties, one green and the other colorless, or nearly so. The body of the green variety is sub-cylindrical, rounded posteriorly with average dimensions of 45 by 5 microns. It has a bright green color, a red stigma, vacuolar and pharyngeal apparatus and spiral surface striations characteristic of Euglena but has three equal-length flagella. The laterally placed nucleus is usually compact with the caryosome obscured. The body is filled with flattened oval "corpuscles" about 2.4 by 1.4 microns. Each of the three flagella has near its origin a swelling which stains intensely with haematoxylin.

The other variety has the following characteristics: body colorless or slightly greenish, conical in shape; stigma lacking, swelling on roots of the flagella lacking; nucleus expanded with caryosome prominent, central in position, in diameter nearly equalling that of the body; surface striations variable, prominent to absent, longitudinal to sharply spiral; flagella variable in number, most having either four or six.

In prepared slides no stages in division of the green variety were discovered but mitosis and amitosis were found for the other. In hanging-drop cultures the green variety multiplied but the colorless one did not. In their typical forms the two varieties are different enough to belong to different species but study of prepared slides has revealed many intermediate conditions which indicate that the green form may transform in to the colorless one.

6. Diphyllobothrium parvum. Thomas Byrd Magath, Mayo Clinic.

In 1898, a patient, Syrian ae. 37, of Dr. Ramsay in Tasmania passed a tapeworm which was sent by Dr. Elkington to Prof. J. W. W. Stephens who described it as "*Dibothriocephalus parvus,*" in 1908. The head was unknown.

In 1920, a patient in the Clinic passed, following treatment, a worm which was identified as *Diphyllobothrium parvum.* The patient was a female ae. 49, born near Warsaw and altho she came to America at the age of one, she has never returned to Europe. She is known to have had the worm for at least six years. Her home has been for some time in Chicago. This is the second record of infection by this worm and a morphological description is offered.

7. Notes on Acanthocephala from Japan. H. J. Van Cleave, University of Illinois.

There have been no published records concerning the acanthocephalan fauna of Japan. A collection received from Professor S. Goto contains a new species of the genus Arhythmorhynchus, larval representatives of the genus Centrorhynchus, and three new species of the genus Acanthocephalus. Of these last, one species is from the intestine of an eel while the remaining two are from amphibians.

The amphibian parasites are of especial biological interest because of evidences which they present of a close parallelism between members of the genus Acanthocephalus infesting European and Japanese Amphibia. A species from Japanese urodeles bears strong resemblances to *Ac. falcatus* of European urodeles but displays unquestionable specific distinction from it. In similar manner specimens of the same genus from Japanese Anura closely parallel the European species *Ac. ranae.*

The parallelism involves not only sizes of critical structures such as proboscis hooks and embryos but also extends to the tendency for variability in numbers of hooks which is much more pronounced in the anuran parasites than in the species from urodeles.

8. The relations between the food of frog and toad tadpoles and their intestinal protozoa. R. W. Hegner, Johns Hopkins University.

During the early stages of metamorphosis of green frog tadpoles Opalinae are numerous in the rectum but not in the intestine. During intermediate stages the Opalinae appear to migrate into the intestine and in late stages and in young and old frogs they disappear entirely. Infection of the green frog with Nyctotherus, Trichomonas and Hexamitus is continuous from tadpole to adult; and infection of the leopard frog and toad with these intestinal protozoa as well as with Opalina is also continuous from tadpole to adult. The incidence, distribution and numbers of these protozoa become modified under experimental conditions as follows. Opalina is rarely present in tadpoles after these are kept without food for two weeks; Nyctotherus disappears usually in about one week; but Hexamitus persists in considerable

numbers for a long period. Tadpoles of the green frog were fed on various glandular substances including desiccated thyroid, thymus, ovaries, prostate, pituitary, suprarenal and orchic. The most striking results were obtained with thyroid, which changed considerably the distribution and numbers of protozoa in the digestive tract. In heavily infected tadpoles Opalinae were most numerous in the rectum and only few in number in the intestine. After a diet of thyroid for 4 or 5 days the Opalinae were found to have migrated from the rectum to the intestine. Such a migration also occurs during normal metamorphosis and hence the conclusion is reached that the change is due not to the thyroid but to the rapid metamorphosis of the tadpoles brought about by the thyroid diet.

9. The use of the pure culture and the guinea pig in biological studies of parasitic nematodes. B. H. Ransom, U. S. Bureau of Animal Industry.

The growing of pure cultures of bacteria and the use of the guinea pig as an experimental animal are commonplaces of bacteriology. The "pure" culture and the guinea pig, however, have been but little used in biological investigations on parasitic worms. Their usefulness in this field are nevertheless very great. Large numbers of larvae of various parasitic nematodes can readily be reared to the infective stage in "pure" cultures containing only one species of nematode. When introduced into the guinea pig the infective stages of parasitic nematodes, even in the case of species that in nature appear to be narrowly limited in their choice of hosts, often establish themselves and undergo developmental changes and migrations similar to those that occur in the usual hosts. The "pure" culture and the guinea pig in the writer's experience have been very useful not only in investigations on the life history of Ascaridae but are continuing to be serviceable in life history studies of other monoxenous nematodes. For example, it has been found that the larvae of the gapeworm (*Syngamus trachealis*) in the infective stages will migrate to the lungs of the guinea pig and undergo development there to a later stage, that the infective larvae of certain strongyles of the horse will establish themselves in the wall of the intestine of the guinea pig; and that the larvae of the stomach worm of ruminants (*Haemonchus contortus*), when introduced into the guinea pig, will continue their development and grow to a considerable size.

10. Studies on Necator suillus, parasitic in pigs. James E. Ackert and Florence K. Payne, Kansas State Agricultural College.

Recent hookworm investigations in Trinidad, British West Indies, showed that native pigs were infested with a new parasite, *Necator suillus* Ackert and Payne, 1922. Post mortem examinations of swine and culturing samples of pig feces from various localities indicated that *N. suillus* is of frequent occurrence and wide distribution on the Island. Pigs of all ages were subject to infestation with *N. suillus*, but those five or more months of age showed both a higher percentage of infestation and a large number of hookworms. This may have been due to the custom of severely limiting the pigs' ranges which becoming polluted with the hookworm eggs made ideal culture media for the larvae during the rainy season. Results of several attempts to infect young pigs with infective larvae of the human hookworm, *N. americanus*, administered *per os* and on the skin indicate that *N. americanus* cannot mature in the pig, although a typical case of "ground itch" was produced on a young

pig's body. Morphological studies on live and preserved specimens of human and of pig hookworms, and comparisons with descriptions of other species of *Necator* indicate that there are now four known species of this genus viz., *N. americanus* Stiles, 1902; *N. exilidens* Cummins, 1912; *N. congolensis* Gedoelst, 1916; and *N. suillus* Ackert and Payne, 1922.

11. The life-history and development of the mite, Myobia musculi, Schrank. HOWARD E. ENDERS, Purdue University.

Specimens of the mites were collected from the heads and bodies of the brown rat, *Mus norwegicus*, and from white rats and house mice. The legs of the mites are very short and thick, but the first pair is modified remarkably into devices fitted to clasp the hairs of the host. Its eggs are attached to hairs, very close to the skin. When the young emerge from the eggs they possesss six legs, of which the first pair possesses the characteristic clasping devices. By means of these claspers they attach themselves between two hairs in such relation that the beak is thrust deeply into the skin of the host. Two molts succeed one another and lead to the development of the adult individual upon the skin of the host animal.

Early descriptions account for the passage of the nymph into the hair follicles where it was said to feed and to transform into the adult condition.

Myobia musculi was reported by Osborn from the heads of mice.

12. The effect of carbon tetrachloride on intestinal protozoa. A preliminary note. M. J. HOGUE and C. VAN WINKLE.

The effect of carbon tetrachloride has been tried on cultures of *Trichimonas hominis, Embadomonas intestinalis* and *Spirochaeta eurygyrata*. In all cases the organisms were killed by the addition of one small drop of the drug to a cover glass preparation.

Kittens infected with giardia and spirochaetes were given one cc. of carbon tetrachloride. The giardia cysts usually disappeared from the stools for 6 or 7 days following the treatment. They would then reappear. Another dose of carbon tetrachloride would cause them to again disappear for a few days after which they would reappear. Spirochaetes appeared at irregular intervals in the stools of the kittens in spite of the treatment with carbon tetrachloride.

A child infected with *Trichomonas hominis* and *Endamoeba nana* is being treated with carbon tetrachloride. *Endamoeba nana* cysts appeared in the stools in large numbers the day after the administration of one cc. of carbon tetrachloride. Since then they have been absent. The *Trichomonas hominis* still appear in cultures of sodium chloride-serum water. The patient is under observation and is still receiving treatment.

13. A new genus of trematodes from the Eastern painted turtle. HORACE W. STUNKARD, New York University.

A very small blood fluke was discovered in the arteries of Chrysemys picta taken in New York and New Jersey. These trematodes belong to a new genus in the subfamily Spirochinae and constitute a third genus in that group. To them the name Haematotrema parvum is given. Sexually mature worms measure 0.75 to 2 mm. in length and 0.05 to 0.12 mm. in width. They may be briefly described as

follows: Exceedingly small and slender monostomes with delicate body which tapers towards both ends. Oral sucker large, elongate, protruding; relatively long esophagus and esophageal glands not strongly developed; intestinal crura sinuous, extending almost to the posterior end of the body. Testes lobed, four or five in number, situated in the anterior part of the posterior half of the body; seminal vesicle between testes and cirrus sac; genital pore below the cecum of the left side, one fourth of the body length from the posterior end. Ovary lobed, on the right side, at or slightly anterior to the level of the genital pore; vitellaria envelop the ceca throughout their length and fill the intercecal area anterior to the testes and posterior to the ootype; seminal receptacle and Laurer's canal present; uterus short; eggs very large, operculate, discharged singly.

14. Cross-infection of Muscoid flies with Herpetomonas. Elery R. Becker, Johns Hopkins University. (Introduced by W. H. Taliaferro.)

With two or three exceptions, the workers who have investigated the flagellate parasites of non-biting flies have been influenced by the theory that each host species is parasitized by a distinct species of flagellate, with the result that the literature contains descriptions of flagellates hardly morphologically distinguishable, such as Herpetomonas muscae-domesticae, H. sarcophagae, H. calliphorae, H. luciliae, etc.

Examination of the intestinal tracts of a number of North American muscoid flies indicated that they may be infected with a Herpetomonas which shows no more morphological variations in hosts of different species than it may show in different hosts of the same species. In order to determine whether or not there might be physiological variations which rendered these flagellates, which apparently belonged to the same species, specific for their hosts, a number of cross infection experiments were undertaken. "Clean" flies of the following species were bred in the laboratory: Musca domestica, Lucilia sericata, Phormia regina, Chrysomyia macellaria, Calliphora erythrocephala, Sarcophage bullata, and Sarcophaga securifera. In none of these species could there be found any hereditary transmission of a Herpetomonas infection. "Clean" flies belonging to each of these six species were then fed the contents of the intestine of infected "wild" flies of the other species. In no instance was there failure to infect. A number of flies of each species approximately equal to the number of flies used in each experiment were kept under the same conditions as controls. In no case did the controls become infected.

The results of the experiments prove that the herpetomonad parasites of the common muscoid flies are non-specific for their hosts.

15. Interactions between protoplasmic masses as a means of determining physiological variations in Arcella. B. D. Reynolds, Johns Hopkins University. (Introduced by R. W. Hegner.)

Kepner and Reynolds (in press) have shown that, if a pseudo-pod is severed from Difflugia and the two parts, i.e., the organism and the severed fragment, are placed near each other, restitution of the whole is usually accomplished by fusion. This phenomenon has been observed to hold true for several genera of Rhizopods. In the course of further investigations the writer has found, in attempting to cause fusion between pseudopods that had been severed from one specimen and other individuals of the same species, that frequently instead of fusion taking place, there

would be a violent contraction of the involved protoplasm, accompanied by a shattering of the fragment, and sometimes also the contracting pseudopods of the organism, after which the animal would move away leaving the bead-like masses of protoplasm behind. By applying this principle it is possible to determine that:

(a) Under similar environmental conditions cross-fusions between protoplasmic masses from specimens belonging to the same pure line cease after about the 22nd generation, i.e. shattering of protoplasm occurs.

(b) By slightly altering the enrivonment in one pure line, this phenomenon can be greatly hastened—the time required for negative reaction being reduced to five or six generations.

(c) By keeping both lines in an identical environment (the same concavity) cross-fusion will continue through at least 150 generations. (This experiment is still in progress).

(d) After specimens from different branches of the same pure line have become negative to each other, cross-fusion can be induced again by placing them in the same concavity; the length of time required to bring this about apparently depending upon how long the negative state has persisted.

16. Variations in Taenia saginata, the "beef" tapeworm of man. FRANKLIN D. BARKER, University of Nebraska.

A comparative study of 300 mature proglottids from 30 specimens of *Taenia saginata* reveals frequent and marked variations in the genitalia. Variations in the shape and size of the ovaries and vitellarium were especially noticeable. We have found proglottids in which was duplicated the condition as described in *Taenia philippina* by Garrison, 1907 and as described in *Taenia confusa* by Chandler, 1920. We have found ovaries and vitellaria very similar to those described by Guyer, 1898 for *Taenia confusa*. We believe that the variations in *Taenia saginata* are more extensive than heretfore considered.

A comparative study of gravid proglottids and eggs is now in progress.

17. The chromosomes in Ascarus lumbricoides of man. FRANKLIN D. BARKER, University of Nebraska.

A large number of eggs from three fertile female acarids of man were studied. The number of chromosomes was found to be forty-eight, the size and shape of chromosomes and the chromosome complex was the same as that described by Boveri, Carnoy, Fürst and Edwards for *Ascaris suum* (*Ascaris lumbricoides* from the pig).

The recent work of Bakker, 1921 seems, from the histological standpoint to establish the identity of *Ascaris lumbricoides* of man and *Ascaris suum* of pig.

Our work of the chromosomes would substantiate this conclusion.

B. CYTOLOGY AND HISTOLOGY

18. Cellular elements in the perivisceral fluid of the Echinodermata. JAMES E. KINDRED, Western Reserve University.

Leucocytes alone are present in the perivisceral fluid of the Asteroidea studied; leucocytes, colorless amebocytes and vibratile corpuscles in the perivisceral fluid of the Ophiuroidea; leucocytes, colorless amebocytes, pigmented amebocytes and

vibratile corpuscles in the Echinoidea; and leucocytes, colorless amebocytes and hemocytes in the perivisceral fluid of the Holothuroidea.

The leucocytes found in the perivisceral fluid of the representatives of the classes of Echinodermata studied, are characterized morphologically, by flap-like processes of the ectoplasm and a granular endoplasm containing vacuoles. The content of the vacuoles is acid in reaction. Physiologically the leucocytes are phagocytic, thrombocytic, scleroblastic and fibroblastic.

Amebocytes containing red pigment vacuoles are characteristic of the Echinoidea, and from their concentration in the regions of the ampullae of the respiratory tube feet, they are assumed to be associated with respiration.

Different concentrations of hemoglobin are present in the non-ameboid hemocyte characteristic of the Holothuroidea. The hemocytes of Stichopus are very minute and flagellated, while those of Cucumaria are large and have a prominent nucleus.

A saturated solution of methylene blue in seawater stains the vacuoles of all the leucocytes. The colorless amebocytes of the Holothuroidea are the only other cells of the perivisceral fluid which are affected by this stain.

Neutral red in seawater stains the vacuoles of the leucocytes a reddish orange. The vacuoles of the colorless amebocytes of the Holothuroidea are stained a cherry red with neutral red.

19. The application of the Bielchowsky-Paton method to the nervous system of the earthworm. (Lantern.) W. M. Smallwood, Syracuse University.

Thus far this silver-gold method has reacted only on the nerve-fibers in the several organs of the earthworm, and does not enable me to trace the different kinds of fibers in the nerve trunks to the ventral ganglia. It, however, reveals that the distinction between efferent sensory and motor nerves is not as sharp as previously stated, and that the nervous system is very much more extensive and comprehensive in its relation to the various organs than hitherto reported. There is a profuse plexus in the muscles, nephridia, peritoneum, blood vessels, and intestinal wall in which the nerve fibers that end in muscles are continuous with those that end in the cells of the nephridia. This plexus seems to be continuous from the free-nerve endings in the epidermis to the free-nerve endings in the intestine. Nerves have been traced from the longitudinal muscles to nephridia and from the muscles in the intestinal wall to their free-ending between the digestive epithelial cells under the oil-immersion lens. Specific end-organs in the muscles and nephridia are shown by this method.

20. Lutear cells in the gonads of the Phalarope. (By title.) Harry B. Yocom, University of Oregon.

A histological study has been made of the gonads of the Northern Phalarope (*Phalaropus lobatus*, Linn.) to determine whether or not there exists any correlation between the presence of lutear cells and the color differences of the two sexes. In this group of birds the female is more brilliantly colored than the male, especially in the breeding plumage.

Material was collected during both the spring and fall migrations. The ovaries taken at both times show the characteristic packets of lutear cells in the tissue around the oocyte follicles. They seem to be slightly more conspicuous in the ovaries

of the birds taken in the Fall at which time the females have lost part of their bright colors and the two sexes are more nearly alike. A study of the testes failed to reveal any packets of lutear cells and differential stains did not bring out any cells which might unmistakably be considered lutear cells.

This evidence would indicate, in the Phalarope at least, that the suppression of color in the male is due to some factor other than the presence of lutear cells in the testis. The question arises whether or not we are dealing with the same problem in considering the coloring of birds such as the Phalarope as in considering hen-feathering in fowls where there is not only a color difference but a structural difference in the feathers as well.

21. The nature of the division of neuroblastic cells in the regenerating spinal cords of Amphibian larvae. DAVENPORT HOOKER, University of Pittsburgh School of Medicine.

Injuries to the spinal cord of Amphibian larvae (Amblystoma and Rana) produce proliferation of cells of neuronal type during regeneration. This proliferation is accomplished by mitotic division of indifferent cells situated in the mantle layer, usually close to the ependyma. Such divisions are found in experimental animals of all ages up to and including metamorphosis. In the cords of young normal embryos many such mitoses are found, but they are rare in older larvae.

The identification of these cells as of neuronal potentiality rests upon their cytological characters, their position and the known increase in number of neurons during regeneration. A neuroblast may be regarded as a neuronal cyton only when it has processes. Such cells do not divide. The indifferent neuroblastic cells provide the additional neuronal elements by mitotic division.

Careful examination fails to elicit any evidence of the presence of amitotic cell divisions in the spinal cord in any of the larvae studied. In many instances two cells lying in close apposition present figures which so strikingly simulate amitoses that it is at times difficult to establish their real nature.

These observations are of interest in connection with the work of Agduhr, 1920, who reports the presence of amitotic divisions of neuroblasts in young mammals following exercises. The observations reported above would make it appear probable that Agduhr has misinterpreted his material.

22. Sources of nutriment during the metamorphosis of fresh-water mussels. LESLIE B. AREY, Northwestern University Medical School.

The nutriment necessary for the metamorphosis of a larval mussel while parasitic on its fish-host is gained from three distinct sources:

1. The bitten host-tissue is utilized by extracellular digestion in the mantle cavity and by phagocytic ingestion and intracellular digestion within the mantle cells.

2. Following this period of tissue reduction, the larval adductor muscle breaks down and is transported bit by bit by amoeboid cells to the mantle which receives the fragments, reduces them to finer particles, and converts them to available food.

3. Fluid interchange between host and parasite undoubtedly occurs. This, however, is not mediated through the vessels clasped by the valves during attachment; on the contrary, it is by general diffusion of the tissue juices which bathe the encysted glochidium.

23. The typical form of polyhedral cells in plant parenchyma and in human epithelium. (Lantern.) FREDERIC T. LEWIS (introduced by Herbert W. Rand), Harvard Medical School.

The typical form of cells, when subjected to the mutual pressure of similar cells on all sides, has apparently never been determined objectively. Usually they are described as rhombic dodecahedra, on mathematical grounds, and because they tend to be hexagonal in both vertical and transverse sections. Kieser (1815) considered that in vegetable parenchyma the rhombic dodecahedra are truncate above and below, thus having the top, base, and two sides hexagonal, and the remaining eight sides quadrilateral. Plateau, Kelvin, and others postulated that space would be divided with minimal partitional area by bodies with 14 sides, 8 hexagonal and 6 quadrilateral—*tetrakaidecahedra;* but Thompson (1917) concludes that "very probably . . . the rhombic dodecahedral configuration, even under perfectly symmetrical conditions, is generally assumed." This we find not to be the case. In the pith of *Sambucus canadensis* the contacts of 100 cells were counted, with the result here tabulated, the lower row of figures showing the number of cells having the number of surfaces indicated by the figure above.

No. of surfaces	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No. of cells	1	1	2	0	2	8	9	20	16	19	10	2	3	6	1

Average number of surfaces, 13.96. Forty cells, reconstructed in wax from serial sections, vary greatly, but usually have hexagonal surfaces above and below, and are hexagonal in vertical section, with an equatorial ridge. These models (made by Ethel S. Lewis) will be shown, and interpreted as approximate tetrakaidecahedra. Examination of the smaller cells of human stratified epithelium is more difficult. A preliminary study of ten cells yield an average of 13.8 contacts. Models will be shown.

C. UNCLASSIFIED

24. Fiji-New Zealand expedition from the University of Iowa. (60 min., lantern.) C. C. NUTTING, University of Iowa.

A popular account of the experiences of the recent Fiji-New Zealand expedition, including contacts with the natives as well as with the animals with which the expedition was immediately concerned. Among other specimens collected are four living sphenodons one of which will be exhibited. The entire account will have a decided zoological "slant."

25. Observations of biological science in Russia. H. J. MULLER, University of Texas.

In a visit to Russia during the past summer the author found the biological scientists far more active than is generally supposed. They are in the main gathered together in a series of large state research institutions. Among these is Koltzof's "Institute of Experimental Biology," with laboratories in Moscow and two stations in the country, for work in hydrobiology and genetics, respectively. At the latter, under Lebedof, work on fowl and rodents, including crossing-over studies, and studies of enzymes genetics is being done. Lazarif's well equipped "Institute of Physics and Bio-physics" with a staff of about 50 scientists, is developing and testing

out important theories of the physico-chemical mechanism of excitation and conduction. There are various other interesting biological institutes in Moscow and Petrograd, but space does not permit mention of their work here, except to suggest their scope by reference to a few salient researches, such as the cultivation of the typhus germ (Barikin and Krich); the development of micro-methods in enzyme determination (Bach); the work of Ivanov on sperm; of Vavilov on cereal variation; of Martsinovsky and others on malaria organisms, Leishman-Donovan bodies, etc. Experimental work is also being done in the universities: for instance, Isaiev's work on interspecific transplantation in hydra, and Nicolaeva's on chromosome aberrations.

Although living in Russia is still subject to great hardships, conditions are improving and the scientists are hopeful. Their most crying need, in their work, is for communication with the Western world—periodicals, books, and exchange of visits.

26. The proper wording of titles of scientific articles. E. W. Gudger, American Museum of Natural History.

Experience in bringing together into a complex analytical subject catalogue the 43,000 titles of fish literature embraced in the "Bibliography of Fishes," now being issued by the American Museum of Natural History, emphasizes the need for better and more complete titles for scientific articles.

Our work has showed that thousands upon thousands of titles give either no idea or else a faulty one of their contents, and the necessity for clearing them up by actually seeing the articles has added many months of time and many hundreds of dollars to the cost of completing this subject-catalogue.

The title of a scientific article should state as accurately and clearly as possible just what the article treats of, anatomy, embryology, physiology, etc.; or if it treats of some obscure structure or function, that structure or function should be named; then the scientific and the common name of the beast should be given, and its class named, i.e., fish, amphibian, bird, etc.

Scientific articles are written to diffuse knowledge, but the intermediates through whom this diffusion is effected are bibliographers and librarians, and their helping hands are badly tied by the insufficient and misleading titles of a large number of scientific books and articles.

27. Variations in coat-color within a single subspecies of mice of the genus Peromyscus. (Lantern.) H. H. Collins, University of Pittsburgh. (Introduced by E. F. Adolph.)

A study of the various factors which determine the color differences within a single subspecies, involving both field studies and laboratory experiments has shown the following: (1) Changes in color due to fading and abrasion are slight. The color differences observed within a subspecies and described as "buff" or "light" and "dark" or "gray" phases cannot be ascribed to seasonal changes through which any individual may pass during the year. (2) These color phases are not due to environmental differences, acting during the lifetime of a single individual or even within a few generations. Individuals representing both extreme phases have been taken in the same locality. Furthermore their descendants, reared in captivity under identical environmental conditions for several generations, have bred true to

type. (3) The buff or light phases do not, as has been suggested, represent old as contrasted with younger adults. Specimens kept in captivity for a period of nearly six years have not undergone any such change. (4) The differences in color are mainly genetic in character. The offspring of buff and dark parents are likewise buff and dark and moreover these differences are apparent soon after birth. When the buff and dark strains are crossed, the offspring are of an intermediate character. The F_2 generation is also intermediate in coloration.

D. ENTOMOLOGY

28. Afferent and efferent pathways in Dendroides. William A. Hilton, Cornell University.

The larva of this small beetle has many advantages for study. The flat body and nearly transparent tissues make it possible to follow all the nerves in abdominal segments.

The single lateral branch from each ganglion is evidently mixed but parts of it could be clearly analyzed into afferent and efferent components.

Many fibers of the dorsal sensory nerve pass to the ganglion above before terminating. The results of experimental stimuli to body segments confirm this distribution. The sensory branches of each ganglion have no wider distribution than the segment to which their ganglion belongs. This is also probably true of motor branches with the possible exception of some of the nerve strands which supply the heart.

So far as studied, sensory endings were by means of bipolar cells ending chiefly in hollow hairs. Similar cells were seen in association with muscles, perhaps for the reception of the muscular sense. The true motor endings were clearly of another type. Unipolar or bipolar cells located in the ganglia on the same or opposite side send out processes to muscles. The branches from motor nerves run out parallel to the muscle fibers and terminate as long twigs or decided end brushes The number of sensory nerve cells in a segment was easily determined. This number was compared with the fibrillae of the nerve trunk and some suggestions made as to the constitution of fiber and fibril.

29. Ant larvae. (Lantern.) W. M. Wheeler, Harvard University, and G. C. Wheeler, Syracuse University.

While the classification of insect larvae has made notable advances since the days of Linnaeus, ant larvae have been generally neglected. This neglect has been due to lack of interest rather than to such difficulties in rearing and determining material as one encounters among other groups. We have studied the larvae of 125 of the 268 genera of ants with the result that we have been able to prepare keys for the subfamilies, tribes and genera. It has also been possible to clear up doubts which myrmecologists have entertained concerning the taxonomic affinities of certain genera (*e.g. Gigantiops* and *Leptanilla*).

The larvae of the Dorylinae and Cerapachyinae are elongate, slender, cylindrical, and nearly straight, with the mouth-parts reduced. The Ponerine larvae with their swollen bodies and stout mandibles are most like the larvae of the social wasps and probably represent the ancestral type. The trophorhinium, or triturating apparatus

elaborated on the mouth-parts, attains its maximum development in this subfamily. The larvae of the four Pseudomyrmine genera are straight and subcylindrical and present a striking assemblage of unusual structures, such as exudatoria and the trophothylax, or larval "feed-bag." The larvae of the Formacinae resemble those of the Ponerinae, but the mouth-parts are more specialized. The Myrmicinae are a heterogeneous group. The plump, chunky Dolichoderine larvae with ventrally placed head and vestigial mouthparts are the most specialized.

30. Further observations on the digestive system of the periodical cicada. Charles W. Hargitt and L. M. Hickernell, Syracuse University.

The morphology of the digestive system in the several embryonic stages is described, and the developmental history of the parts of the system outlined. None of the findings warrant any change of view in interpretations made upon adult material in an earlier paper. The embryonic material throws much light upon the functional significance of parts of the system which up to this time have not been completely understood.

Attention has also been directed to matters of physiology and correlated phases of behavior, especially those of food taking as related to adult life and reproduction. This will be shown to have relations to the anomalous aspects of larval life, among them the excessive development of the "fat-body" in this insect. Comparison is made with similar provision in several other organisms, both among insects and vertebrates, going to show adaptation to the stress involved in the growth and rapid maturation of the sex products, and the laborious deposition of the eggs, all of which is comprised within the brief period of two or three weeks of adult life. Brief notice is taken of some recent views touching the problems concerned.

E. EMBRYOLOGY

31. Periodicity in the production of sexual cells in marine animals. B. H. Grave, Wabash College.

The experience of members of the teaching staff and of various investigators at Woods Hole indicates that there is a lunar periodicity in the maturing of germ cells in the starfish, the sea urchin and *Cumingia* as well as in *Nereis* and *Chaetopleura* which have been previously described. Notes of various investigators show that *Cumingia tellinoides* sheds its gametes most abundantly at the time of the full moon and possibly at the new moon; i.e. fortnightly maxima.

This periodicity is not readily apparent during the height of the breeding season but comes out clearly toward the end.

32. Germ cell and germ gland development in male Rana catesbciana tadpoles. W. W. Swingle, Yale University.

Different races differ in testicular development. Two methods of testis formation occur, direct and indirect, each characteristic of various local races. Eight races were examined, five exhibited indirect, three the direct method of testis formation. The problem has nothing to do with sex determination or sex transformation but is a cycle of degenerative and regenerative processes in testis development-processes

comparable in many respects to the annual cyclical changes of the testis of certain urodeles.

Characteristics of indirect testis formation are as follows: delay in formation of the definitive sex (rete) cords with consequent persistence and thickening of the germinal epithelium—definitive sex cords may not be formed for two years or more in some races; abortive maturation cycle produces spermatocytes and sometimes aberrant spermatids; degeneration of all maturation cells; the lobules of the pro-testis (larval gonad of races exhibiting indirect testis formation) contain residual spermatogonia; definitive sex cords form, and cross tubules grow out to the residual spermatogonia of each pro-testis lobule; part of the residual spermatogonia migrate down the tubules into the sex cords and by rapid multiplication form the anlagen of the definitive testis which develops as a core of sex-cords and residual spermatogonia surrounded by degenerating pro-testis lobules; residual spermatogonia of the pro-testis regenerate the lobules and these also become a part of the definitive testis.

Evidence exists that races with direct testis formation undergo an abortive post-larval sexual cycle culminating in degeneration of the male sex products.

33. The microdissection of the egg of Cerebratulus. GEORGE A. BAITSELL, Yale University.

The following results have been obtained from a series of micro-dissection experiments on the eggs of Cerebratulus: The egg membrane, which forms when the eggs are placed in sea water, is a great hindrance to microdissection. It can be removed (Chambers, '17) without injuring the eggs by forcing them through a fine meshed cloth. Such eggs appear to be naked, but the presence of a very delicate membrane may be demonstrated with the needle. A prominent germinal vesicle, with a nucleolus, is present in the eggs for several minutes after they are placed in the sea water. It possesses a definite nuclear membrane which is very sticky. This can be shown by bringing the point of the needle in contact with it. Frequently the membrane will stick so tenaciously to the needle that the entire nucleus can be drawn through the surrounding cytoplasm and completely out of the egg. The nuclear membrane can then be removed from the nucleus. In such cases the prominent nucleolus rapidly disappears, and, shortly, the nuclear membrane also fades from view. The rest of the nucleus, however, persists as a transparent, homogeneous body, and it can be shown by microdissection to be a rigid gel, the pieces of which show no tendency to alter their shape in the sea water. The experiments thus far made on the eggs indicate that changes in the viscosity of the cytoplasm occur, but the results obtained do not entirely agree with those of previous investigators.

34. The presence of copper in Arbacia eggs. OTTO GLASER, Amherst College.

Copper can be demonstrated in Arbacia eggs by a variety of methods. It can be localized directly by means of specific reactions, indirectly by analysis of egg secretions. The quantities involved per cubic centimeter of eggs are seventeen micrograms for unripe ovarian eggs, 175 for ripe shed eggs and 21 for fertilized eggs. The copper is found associated in part with lipolysin; it is also associated with preparations of pancreatin and pepsin. These facts are the basis for certain suggestions regarding the mechanism of oligodynamic action of heavy metals.

35. Analysis and interpretepretation of lithium effects in echinid embryos. J. W. MacArthur, University of Toronto.

Characteristic *structural* modifications induced by lithium in embryos of sand-dollar and sea urchins were, as in Herbst's data changes: (1) in general form and relations (degrees of exogastrulation); and (2) in proportion of parts.

For a *physiological* analysis the physiological gradient conception of Child was found most helpful. In high concentrations lithium caused general inhibition of development; in lower concentrations the retardation was rather sharply localized, for growth and mitosis were slowed down or stopped in apical regions (animal pole; ectoderm), but little or not at all diminished in basal regions (vegetal pole; entoderm; mesenchyme). In extreme cases ectoderm was reduced to the vanishing point, while entoderm and mesenchyme underwent a reciprocal hypertrophy at its expense. Significantly, in such types the fore-gut is most increased, and the hind-gut least. Regarding exogastrulation it is suggested that it is almost impossible mechanically for a greatly enlarged entoderm to invaginate into a very small blastocoel already visibly overcrowded by excess of proliferated mesenchyme.

In susceptibility to KNC, etc. normal embryos show a distinct apico-basal gradient (ectoderm > entoderm > mesenchyme), but in lithium-modified embryos clearly this gradient is levelled down and finally quite completely reversed (mesenchyme-entoderm > ectoderm).

The lithium modifications appear to follow logically and necessarily form the altered metabolic relations of the reversed gradient, just as the normal proportions and relations of parts follow from the usual metabolic relations.

36. Cryptorchidism experimentally produced. Carl R. Moore, University of Chicago.

If rat or guinea pig testes are replaced in the peritoneal cavity for three to four months (inguinal canals open or closed) the testis is histologically typical of an undescended testis. The germinal epithelium is absent; the small seminiferous tubules contain besides a reticular mass, a single layer of cells usually poorly stained (considered Sertoli cells); the interstitial cell mass is abundant.

If but one testis has been so treated, or if both were replaced in the peritoneal cavity and one subsequently returned to the scrotal sac, the one remaining in the cavity will be typically cryptorchid whereas the scrotal testis is normal.

Seven days after operation degeneration of the testis is evident; at fourteen days well advanced; and at twenty to thirty days the germinal epithelium is usually absent. In the process of degeneration the epithelial cells unite into discrete syncytial masses, similar to giant cells, in the epithelial layer or free in the lumen of the tubule.

If the scrotal sac is everted and fastened in the peritoneal cavity (with testis) a similar degenerate testis is produced. The vas deferens, blood supply, nerve supply and scrotal sac connections are normal.

After considerable degeneration has taken place, the testis will recover and return to normal if replaced in the scrotal sac (data incomplete to date).

Since factors such as infection, greater pressure, severance of blood or nerve supply and scrotal sac connections have been eliminated as causes of degeneration, it is suspected that differential body temperature may be a factor.

37. Iodine and anuran metamorphosis. (Lantern.) W. W. Swingle, Yale University.

Three groups of thyroidectomized and hypophysectomized Rana sylvatica tadpoles were used in the experiment. One group was fed tyrosine; another group was fed tyrosine in which two atoms of iodine had been substituted for two hydrogen atoms of the molecule forming the compound 3–5-diiodotyrosine. The third culture received equivalent quantities of 3–5 dibromtyrosine-tyrosine in which two bromine atoms had been substituted for two hydrogen atoms.

The tyrosine and dibromtyrosine-fed animals showed no evidences of metamorphic change after two months of continuous feeding; conversely the iodotyrosein-fed tadpoles metamorphosed (except for the presence of the tail stump in pituitaryless animals) within twenty days from the date of first feeding.

A similar experiment was carried out on Rana clamitans tadpoles with intact thyroid glands. The iodotyrosine-fed animals metamorphosed within twenty days. The tyrosine and dibromtyrosine-fed animals showed no indications of transformation after two months of continuous feeding.

Anuran metamorphosis is dependent upon a peculiar property inherent in the iodine atom when combined in a certain way. The iodine to be effective need not undergo any transformation within the thyroid gland. Thyroid iodine is by far the most effective in accelerating metamorphosis but other forms of iodine can replace it insofar as metamorphosis is concerned.

Bromine has no influence upon metamorphosis and cannot be substituted for iodine.

38. Iodine and urodele metamorphosis. W. W. Swingle, Yale University.

The following experiments render invalid the conclusion of E. Uhlenhuth that the metamorphosis of urodele larvae is independent of iodine and its compounds and influenced only by the thryoid hormone.

1. The thyroids of axolotls (seven inches long) were extirpated and the animals kept for five months following the operation. They were then injected twice at five day intervals, with strong doses of diiodotyrosine. The animals metamorphose within seventeen days following the first injection. Control thyroidless axolotls injected with equal quantities of pure tyrosine and dibromtyrosine (two atoms of bromine in the molecule) showed no evidences of metamorphosis.

2. Thyroidless axolotls were kept for five months and then injected twice at eight day intervals with iodized serum globulin. Metamorphosis occurred within twenty days. Control thyroidless animals injected with non-iodized globulin failed to transform.

3. Larval Spelerpes varying in length from 23 to 53 mm., were placed in strong solutions of tyrosine, dibromtyrosine, and diiodotyrosine. All animals of the iodotyrosine culture metamorphosed within twenty days. The larvae of the other cultures showed no indications of transformation.

The experiment shows clearly that iodine other than thyroid iodine is capable of inducing metamorphosis. The evidence indicates that metamorphosis is dependent upon a peculiar property of the iodine atom when combined in an unknown manner (not necessarily the combination occurring in the thyroid) because the iodine compounds effective in metamorphosing thyroidless amphibians have been shown to have no physiological effect upon thyroidless mammals.

39. Experiments on metamorphosis. (Lantern.) KARL E. MASON, Yale University. (Introduced by W. W. Swingle.)

1. Thyroidectomized and hypophysectomized Rana sylvatica tadpoles were reared in solutions of elemental iodine and fed starch iodide and spirogyra. Metamorphosis resulted, though the animals died before the tail was completely absorbed

2. The thyroid glands of a large axolotl were extirpated, cut into ten pieces and each piece transplanted into a Rana sylvatica tadpole. Two pituitaryless, three thyroidless and five normal animals were engrafted. Three normal larvae were injected with the water in which the glands had been cut into pieces. The thirteen tadpoles metamorphosed within two weeks. Thus the thyroid glands of a single axolotl contained enough secretion to metamorphose thirteen thyroidless, pituitaryless and normal animals when transplanted or injected. The same glands left undisturbed within the animal's body were incapable of initiating metamorphosis. Axolotl neoteny is apparently due to failure of the thyroid glands to release the hormone.

3. A giant male Rana catesbeiana tadpole 160 mm. long and sexually mature was found to lack thyroid glands. They had evidently been present at one time because the animal had hind legs 22 mm. long. Neoteny due to spontaneous degeneration of the thyroid apparatus is uncommon in Anurans.

4. Efforts were made to metamorphose Ammocoetes larvae of Petromyzon marinus by rearing them in thyroxin solutions, injecting them with strong doses of this substance and lastly by engrafting them with large amounts of thyroid and pituitary tissue of adult frogs. The results were negative.

40. The vascularity of the enamel-organ in the developing molar of the albino rat. WILLIAM H. F. ADDISON and J. L. APPLETON, JR., University of Pennsylvania. (Introduced by C. E. McClung.)

In reviewing the previous work upon the vascularity of the enamel-organ, one notices the variability of the findings, In the albino rat, however, blood-vessels exist within the developing enamel-organ of the molars. They penetrate the external enamel epithelium and traverse the stellate reticulum to the stratum intermedium. They were not seen to penetrate the stratum intermedium and so probably do not come into direct contact with the ameloblasts. The entering blood vessels are always multiple. The time of vascularization of the enamel-organ is closely connected with the beginning of amelogenesis. Connective tissue in growth, following the route of the blood-vessels, plays a part in the ultimate disintegration of the stellate reticulum. A complete description appears in the current number of the American Journal of Anatomy.

41. Experiments on limb posture in Amblystoma punctatum. J. S. NICHOLAS, University of Pittsburgh School of Medicine. (Introduced by R. G. Harrison.)

Previous experiments have been reported which show that the girdle regulates the posture of the limb after the rotation of the limb bud. Subsequent experiments show that the parts which cause this regulation are located in a circle of tissue three-fourths of a somite wide surrounding the limb bud. The limb was rotated within this area, and the outer circle was rotated independently of the limb. These rotations have been carried out in both orthotopic and heterotopic locations. They

show that the limb posture is dependent upon the orientation of the surrounding tissue.

When a limb from one side is placed in the limb area of the opposite side, the outer circle of which has been inverted, there is no reversal of asymmetry of the limb. Reduplication is less frequent than in rotations of the whole limb disc of three and one-half somites.

The limb bud has been blocked by the transplantation of indifferent ectoderm. While this can be done, the distortion of the operative components during healing permits regeneration in a greater number of cases than is usual when the limb area is blocked in the usual location.

The portions of the girdle included in the circle of tissue around the limb bud are the supracoracoid, coracoid and procoracoid. When transplanted, these undergo a slight regulation in which they adjust themselves to the general conformation of the body wall. They maintain their transplanted location and orientation, causing the rotation of the limb bud during its development.

F. COMPARATIVE ANATOMY

44. The origin and nature of the earliest neuromuscular connections in elasmobranch embryos. H. V. Neal, Tufts College, Mass.

A reinvestigation of the earliest stages in somatic nerve histogenesis in Elasmobranch embryos, and a critique of the conclusions of Dart and Shellshear ('22) and of Kerr ('19). The problem of the genesis of the first neuromuscular connections not insoluble, as asserted by Kerr, and not one to be settled by the selection of facts favorable to any hypothesis, however important, as has been done by Dart and Shellshear. The borax-carmine methods used by these authors are inadequate for the solution of problems of neurogenesis.

Neural tube and somite are not primarily in contact with each other, as stated by Dart and Shellshear, but are separated both in living specimens and in well-preserved material by a liquid-filled space free from plasmodesmatous connections. In formal-in-fixed specimens plasmodesmata-like structures may result from plasmolysis. The absence of protoplasmic connection between tube and somite may not be correctly interpreted as a result of rupture in sectioned material.

The earliest protoplasmic neuromuscular connections in Elasmobranch embryos are secondary in formation, neurogenic in origin, and nervous in nature as shown by the presence of neurofibrillar substance. Contrary to the statement of Dart and Shellshear, there is no rythmical movement of Elasmobranch embryos of less than 4.5 mm. total length. Furthermore, there is no movement before nervous connection is established through the outgrowth of processes of medullary neuroblasts. Dart and Shellshear have presented no evidence adequate to establish their assumption of the myogenic origin of somatic motor neuroblasts, and no evidence whatever to prove the statement that the sympathetic is of mesenchymatous (mesodermal) derivation.

45. An undescribed type of sense organ found in the larva of Botryllus. Caswell Grave, Washington University, and Helen Woodbridge, University of Maine.

One sense organ only is developed in the larva of Botryllus while two, an eye and a static organ, are typically present in the larvae of other compound ascidians. The

behavior of the Botryllus larva shows that definite and specific responses are made to stimuli by light and by gravity that are in no way different from the same responses made by ascidian larvae which have both an eye and a static organ. The morphology of the Botryllus sense organ reveals the fact that it is a combined eye and static organ. It consists of the following parts: a pigment cup attached by a slender stalk to the ganglionic wall of the sensory vesicle and a series of five nerve cells the cell bodies of which are located at the base of the sensory vesicle. From each cell body a robust fiber passes forward through the vesicle cavity to the mouth of the pigment cup. Within the cavity of the pigment cup each fiber becomes enlarged to form a sensory end organ which is intimately connected with a papilla in the floor of the pigment cup. The requirements for a simple static organ seem to be met by the fact that the sense organ as a whole hangs pendant within the vesicle by a slender stalk. The requirements for a simple direction eye seem to be met by the structural elements just enumerated, but it is noteworthy that lenses, which constitute a conspicuous element of the eye of other ascidian larvae, are wanting in the Botryllus eye.

46. The morphogenesis of spines and spine-glands in the Siluridae. H. D. Reed, Cornell University.

The axillary dermal glands in catfishes comprise the whole thickness of the epidermis rather than the invagination and proliferation of the cells of the germinal layer. They possess at first no natural pore or lumen. These appear only with the active functioning of the gland.

In a few species there are glands of the same structural type associated with the pectoral and dorsal spines. These spine-glands at first appear to be contrary to all structural and developmental plans prevailing in those of the axillary region. The two kinds are seen to be in morphological harmony when the spine-glands are studied in the light of spine-morphology.

The spines are formed by modified soft rays in the form of conical caps applied one after another to the end. The soft rays of the fins are overlaid by epidermis abundantly provided with gland cells. The lepidotrichia contributing to the formation of the spines do not separate from the basement membrane thus carrying the epidermis to their final position in the spine. The spine glands are therefore, composed of a series of distinct superimposed glands which in the undisturbed estate are without pore or lumen.

47. On specific characters in Teredo. (Lantern.) Thurlow C. Nelson, Rutgers College.

A study of Teredo from various environments in Barnegat Bay, N. J., in 1921 and 1922, shows the presence of true Teredo navalis, L., together with T. morsei, Bartsch, and possibly other varieties. Sexually mature Teredo navalis obtained in 1921 from white cedar in the middle of Barnegat Bay, show typically 14 or 15 dental ridges, and other specific characters which closely agree with those of specimens from the coast of Holland. This Barnegat material has been identified by two of Europe's foremost authorities as T. navalis, L. Teredo in cedar and pine from tidal creek of Barnegat Bay in 1922 show from 25–30 dental ridges, and agree closely with description of T. morsei, Bartsch (T. navalis, var. moresi, Clapp). That the difference

between true T. navalis and var. morsei may be environmental rather than genetic and of specific value is suggested by the presence of intergraded forms. Photomicrographs are shown illustrating the characters of shells and of pallets in Holland and in Barnegat Bay Teredo.

48. Intramuscular sensory endings of the small intestine, with a consideration of their central connections and probable function. F. W. Carpenter, Trinity College.

Intramuscular nerve endings of sensory type occur as minute telodendria in the muscular coat of the dog's small intestine. These arborizations (with the exception of a few in the subserous layer) have been found only in the longitudinal muscle embedded among and in direct contact with the muscle cells. The fibers with which they are connected have been traced into the myenteric plexus. Physiological and clinical evidence points to these arborizations as the pain terminals of the intestinal wall. The fibers which lead from them to the myenteric plexus are believed to be the peripheral processes of sensory neurones, the cell bodies of which are situated in the dorsal root ganglia of the tenth and eleventh thoracic nerves.

49. Glochidial teeth and the mechanics of attachment. Leslie B. Arey, Northwestern University Medical School.

1. The flange of hookless and axe-head glochidia and the hook of the hooked forms are homologous structures. Both are specializations of the primitive valve rim with the undifferentiated remainder of which they are still continuous.

2. Externally the valves of glochidia are covered with a cuticular layer: internally the mantle epithelium is lined with a typical cuticula. The two become directly continuous at the shell's edge. At the region of the flange and hook the junction is on the inside surface and subterminal.

3. All the glochidial types bear teeth on their external surfaces. In the hookless and axe-head forms these teeth are extremely small (0.5–1.5μ) and numerous (several thousand). In the hooked glochidia they become relatively coarse spines along the median ridge of the hook; laterally they diminish progressively in size and may become as tiny as any in the other groups. As an extreme case (Anodonta imbecillis) these teeth extend along the rim and beyond the hinge line.

4. When attachment occurs, adduction causes the rim and flange (including its specialized hook) to cut the tissues until sufficient resistance turns them mechanically inward. Continued pressure flexes these parts at right angles to their original positions, and their external surfaces are opposed and parallel. During the inturning additional host tissue is engaged and locked by the teeth and spines. As a result the glochidium is more firmly attached by a broader zone of pinched and locked tissue.

50. The gall-bladder in the cat,—its development, its functional periodicity, and its anatomical variation as recorded in twenty-five hundred specimens. Edward A. Boyden, Harvard Medical School.

A pancreatic bladder was recently described by the author as developing from an accessory duodenal pancreas. The very existence of such a case seemed to argue against interpreting other types of pancreatic bladders as split portions of the cystic diverticulum. To test this hypothesis twenty-five hundred cats were examined. Three pancreatic bladders were found and over three-hundred multiple gall-bladders,

but no instance of subdivided bile-duct to bridge the gap. Conversely, fifteen aberrant pancreatic lobes were found which reached the gall-bladder and whose ducts reproduced, proximally, all essential conditions exhibited by pancreatic bladders of the usual type. Furthermore, the two pancreatic bladders which were sectioned differed histologically from the gall-bladder, and were pathological. A case similar to Professor Beckwith's (1918), in which an aberrant pancreatic diverticulum emptied into the neck of the gall-bladder, was also pathological, indicating that the connection in both cases was probably fistulous.

In addition to pancreatic and split gall-bladders a new aberrant type was found (twenty-nine cases) in which supernumerary bladders arose directly from the hepatic ducts. Only three instances occurred in which the gall bladder was absent.

Experimental feeding of cats shows that a meal of pure fat induces a cycle of changes in the gall-bladder: 1) a period of slow emptying; 2) a collapsed or resting period marked by a rearrangement of the mucosa; 3) a period of rapid filling and bile concentration. Pure protein or carbohydrate diet induces no resting stage. Mixed and superimposed diets produce various modifications of this cycle.

51. The anatomy of an abnormal double monster (Duroc) pig. (10 min.) George W. Hunter and George M. Higgins, Knox College.

This pig, from a normal litter of six, was artificially delivered and died at birth. The monster has one head with normal mouth, nares and eyes; four external ears, two of which come out on the mid-dorsal line just back of an unexplored wart-like protuberance in the pineal position; eight legs, apparently normal. The bodies, one of which is much larger, are joined in the thoracic regions by their ventral surfaces.

The bodies have a common metacoele. Most of the viscera lie in the body of the larger animal, or in the common portion. The digestive tract is complete for the larger animal, although quite abnormal in some respects, but is incomplete in the smaller body. A relatively short intestine opens into a pouch in the intestine of the larger body.

There are two pleural cavities and two sets of lungs, placed dorsal side to dorsal side. Two trachea are found, the ventral one uniting with the single oesophagus near the larynx. Two hearts are present, dorsal surfaces opposed. Two dorsal aortas connect with each other and with the hearts. There are four jugulars, two precavae and two postcavae, although the venous system appears to be unconnected.

Normal kidneys and ovaries with normal ducts and blood connections are found in the larger body. Sex organs and kidneys are rudimentary in the smaller.

The dorsal vertebral columns appear to be connected in the thoracic regions. The glandular development, especially of the endocrine glands, is relatively great. The thymus, in particular is greatly developed.

G. GENERAL PHYSIOLOGY

52. The creeping of the larvae of the slug-moths (Cochlidiidae). W. J. Crozier, Rutgers College.

Caterpillars of four genera of the slug-moths, lacking pro-legs and having the thoracic legs so reduced as to be functionless in locomotion, creep by means of direct

neuromuscular waves confined to the adhesive ventral surface and similar in many respects to those pedal waves which are the means of progression in gasteropods. The nervous mechanism of coördination is different from that in mollucks, but the speed of the "pedal" wave is in quantitative agreement in the two cases. Reversal of creeping involves reversal of the locomotor wave. The speed of the reversed (retrograde) wave is greater than that of the direct, (by as much as one hundred per cent), although the former is relatively difficult to elicit. The temperature coefficient for the velocity of the "pedal" wave is about 2.3.

53. Photoreceptors of Lumbricus terrestris. WALTER N. HESS, DePauw University.

It is generally known that earthworms are sensitive to light, but little is known concerning the distribution and nature of the photoreceptors.

By the use of ordinary illumination it is possible to demonstrate that worms of this species are most sensitive to light in their anterior regions, somewhat less in the posterior, and least of all, in the middle portions of their bodies.

By means of a strong pin-hole light, the prostomium and the three anterior segments were found to be most sensitive, of which the prostomium appeared to be slightly more sensitive than the rest. Although all segments were found to be photosensitive, each segment, with the possible exception of the first three and the last one or two, was most sensitive in the anterior portion of the dorso-lateral region. No reactions were obtained by illuminating the mid-dorsal areas except those of the twelve anterior and the three posterior segments. The worms did not react to illumination on the mid-ventral surface except on the three anterior and the last segments.

Some of these conclusions were confirmed by tests which were made, following the removal of certain anterior segments and certain parts of the nervous system.

A comparison of the histological structure of the more sensitive with the less sensitive regions, revealed the fact that a rather peculiar type of sense-cell is more abundant in the former than in the latter areas. This indicates that these sense-cells are photoreceptors.

54. Hibernation in Orthoptera. I—Physiological changes during hibernation in certain Orthoptera. JOSEPH HALL BODINE, University of Pennsylvania.

Some physiological changes during hibernation in grasshoppers, such as changes in the water content, the length of life, the rate of growth, the rate of metabolism, etc., are pointed out. It is shown that *Chortophaga viridifasciata* in the vicinity of Philadelphia, hibernates rhythmically at a definite stage in its life cycle and that during hibernation the animals take in food. The animal's ability to withstand cold seems to be related to its water content and the various changes in the percentage of water make it a rather unique organism. During hibernation animals do not grow nor gain in body weight. Hibernating animals, brought and left at room temperature (20° C.) after a short interval during which water content readjustments take place, grow in a normal manner. Rate of recovery from hibernation is quickest in animals brought indoors latest in the hibernation period. Differences in rate of recovery from hibernation, rate of growth, rate of CO_2 output, etc., for males and females are pointed out. Rates of CO_2 output for hibernating animals at 0° to 8° C. are noted,—being eight to ten times lower than at room temperature (20° C.).

Rates of CO_2 output in hibernating animals at room temperature remain higher than in growing animals, suggesting that the animals remain young throughout the period of hibernation. *C. australior*, a species in which hibernation had not occurred, when subjected to hibernating conditions reacts similarly to *C. viridifasciata*. It thus seems possible to induce hibernation in closely related species of animals.

55. Some reactions of Alligator mississippiensis. Albert M. Reese, West Virginia University.

Temperature. When given a choice of pans containing fresh water at 10° C., 25° C. and 40° C., approximately 16% of the observations showed the animals in the coldest water, 60% in the medium temperature, and 24% in the warmest water.

Sea-water. When given a choice between pans of fresh and sea-water the animals gave about 54% to 46% in favor of the fresh water, indicating practically no preference of one medium over the other.

Light. When given the choice between the shaded end of a black painted box and the end illumined from above by a tungsten lamp the animals showed a preference for the dark end in the proportion of 62% to 38%.

Chemical. As might be expected, the tough hide of the animals seems quite unaffected by ordinary chemicals, 5% NaOH or 20% acetic acid producing no reaction. Small wads of cheese-cloth moistened with volatile and odoriferous liquids produced varying responses when suspended near the nostrils. For example the responses to chloroform and ammonia were very marked, often violent, while to concentrated hydrochloric acid, so irritating to the human olfactory membranes, the response was often much less marked. To some of the strong smelling but non-irritating oils no response was noticed.

Food. The animals accepted *every* kind of animal food that was offered, live animals being captured partly by sight, partly by the disturbance of the water and partly by chance.

56. Quantitative observations on the digestive power in Amphibian larvae during metamorphosis. Albert Kuntz, St. Louis University School of Medicine.

Metamorphosis in Amphibia involves a coincident period of fasting during which the secretion of digestive enzymes is markedly retarded. Quantitative data are presented which indicate almost complete suspension both of peptic and amylolytic activity in Rana pipiens and Ambystoma tigrinum during metamorphosis and rapid acceleration of these activities as metamorphosis is completed and feeding is resumed.

57. The effect of light on various marine invertebrates. A. G. Huntsman, Atlantic Biological Station.

Several days' exposure to direct sunlight is found to be fatal to a number of species of marine invertebrates with which experiments have been made. These consist of Crustaceans (e.g. *Calanus* and other Copepods, a Caprellid and a Gammarid among Amphipods, the Schizopod, *Meganyctiphanes*, and the larva of the lobster), Ascidians (the genera *Molgula*, *Boltenia* and *Tethyum*), and a Coelenterate (*Alcyonium* or *Gersemia*). In the experiments controls were used, for which the conditions were kept the same as for the individuals in the experiments proper, except in regard to light. The thesis is advanced that the direct action of light determines the upper bathymetric limits of many marine animals.

58. The axial gradients in Corymorpha palma. C. M. Child, University of Chicago.

The existence of a physiological gradient in the main axis was demonstrated by the susceptibility method with KNC and other agents, by reduction of $KMnO_4$, by vital staining with neutral red and methylene blue, by decoloration of methylene blue, and by comparative colorimetric estimation of CO_2 production. By all these methods except the last a gradient was also demonstrated in each tentacle, each gonophore and each frustule. The apico-basal gradient was also shown to be present in the planula and in early stages of hydroid development and it was found that a new gradient appears in the development of every new axis in the reconstitution of pieces. In short pieces it was possible to determine new gradients and so new axes by differential exposure to environmental conditions.

Estimation of CO_2 was made with phenol red as indicator. Hydranths and stems, apical and basal halves, and apical, middle and basal thirds of the naked region of the stem were compared and all experiments showed a decrease in rate of CO_2 production in the basal direction. In extreme basal regions growth of frustules increases the rate somewhat.

Small sexually immature animals show much higher susceptibility, reduce permanganate more rapidly, stain more rapidly with neutral red and methylene blue, decolorize methylene blue more rapidly and produce CO_2 more rapidly per unit of weight than large, sexually mature animals.

59. Oxygen consumption with respect to level, size, and regeneration and electrical polarity in Corymorpha palma. (By title.) L. H. Hyman, University of Chicago.

Tests were made of the rate of oxygen consumption per unit weight of different levels of the stem of Corymorpha. In all stems used the apical cut is made below the neck region of the hydranth and the basal cut above or at the upper rim of the perisarc. Apical halves of such stems consume more oxygen than basal halves (eight experiments, all positive, average difference, 22 per cent). Apical thirds consume more oxygen than middle thirds (six experiments, all positive, average difference, 40 per cent); and middle thirds more oxygen than basal thirds (six experiments, all positive, average difference, 20 per cent).

The rate of oxygen consumption per unit weight is greater the smaller the individuals; in four experiments, 10–15 mm. specimens consumed 130–300 per cent more oxygen than 40–50 mm. specimens. The difference applies to both stems and hydranths.

Pieces after regeneration have a markedly greater rate of oxygen consumption than the same pieces before regeneration (five experiments, all positive, average increase, 600 per cent).

Hydranths are electronegative (in the galvanometer) to stems and distal levels of stems negative to proximal levels down to the zone of stolons (frustules). This zone is decidedly negative to the stem just distal to it.

60. The manner of copulation in triclad Planarians. R. A. Budington, Oberlin College.

The behavior of triclad flatworms during copulation, if indeed it has been accurately observed, seems not to have been described in monographs on behavior in this group, or to be incorporated in current texts.

Unlike the method in Lumbricus (also hermaphrodite), the two copulants, in the instance of *Planaria maculata*, are oriented in the same direction, side by side, their anterior ends placed flatly on the substratum, their posterior halves so twisted that the ventral surfaces (and consequently genital atrial pores) are closely flattened, the one against the other. The copulatory organ of each worm is protruded through the atrial pore for about 1 mm., at the same time in both copulants, so that exchange of spermatozoa is mutual and simultaneous. The spermatozoa seem to be taken at once and practically wholly into the uterus, sections of ex-copulants showing the uterus and its duct to contain large masses of sperm. Distinct spermatophores, while described for certain other species of *Planaria*, are not apparently formed by *Planaria maculata*.

61. The olfactory sense of the cabbage butterfly, Pieris rapae Linn. Dwight E. Minnich, University of Minnesota.

The cabbage butterfly, *Pieris rapae* Linn., extends its proboscis upon appropriate olfactory stimulation, and this response may be used in locating the olfactory organs. Butterflies collected in the field generally become 100 per cent responsive or nearly so after twenty-four to thirty hours of total inanition. If such animals are subjected to operations eliminating the antennae from possible olfactory function, through coating with vaseline or paraffin-vaseline mixture, or through amputation, the response to olfactory stimulation is decreased by 50 to 80 per cent. If only one antenna is eliminated, the decrease is but one-third to one-twelfth this amount. Strictly comparable data may be obtained by removing one antenna, then the remaining antenna, and making a set of trials after each operation. A group of twenty-two animals, twelve males and ten females, was tested in this manner. Before any operation thay gave 100 per cent response. After the removal of one antenna, they gave 89 per cent response. After the removal of both antennae, they gave 47 per cent response.

It is thus clear that the elimination of one antenna alone produces a relatively small decrease in response, while the elimination of both antennae effects a great reduction in the same. Even the elimination of both antennae, however, fails to abolish the response. Two conclusions may be drawn from these facts: first, the antennae of Pieris bear important olfactory organs; second, the olfactory organs are not limited to the antennae.

62. The stimulating efficiency of intermittent light in the drone-fly, Eristalis tenax. William L. Dolley, Jr., Randolph-Macon College.

The stimulating efficiency of intermittent light in Eristalis may be greater than, equal to, or less than that of continuous light, depending upon the flash-frequency. Five flies were tested in intermittent light of an average illumination of 92 meter-candles and of various flash-frequencies. At flash-frequencies of 14, 20, 25, and 33 per second the stimulating effect of intermittent light was greater than that of continuous light of equal illumination; at flash-frequencies of 2½ and 5 per second it was less; and at flash-frequencies of 10, 40, and 50 per second it was about equal to that of continuous light.

The flash-frequency of maximum stimulating effect varies with the illumination. Each of five insects was tested in intermittent light of 10 and 570 meter-candles.

In the former illumination the flash-frequency of maximum stimulating efficiency was about 14 per second, while in the latter it was approximately 33 per second. Consequently, the stimulating efficiency of intermittent light in Eristalis depends upon the flash-frequency and the luminous intensity.

63. The chemical sense of Palaemonetes vulgaris (Say). MANTON COPELAND, Bowdoin College.

Experiments show that *Palaemonetes vulgaris* finds fish meat concealed in sand, or in a tube covered with cheesecloth and suspended two centimeters from the bottom of an aquarium. Reactions to a baited tube are much more frequent than to one placed nearby similar in appearance but containing no food. The prawn is successful also in finding meat when either the first or the long filaments of the second antennae are removed. When, however, both pairs of organs are excised the location of the food is less frequently or precisely determined, although the behavior of the animal shows unquestionably that it is being sensed. It becomes evident, therefore, that neither the first nor the second antennae are to be regarded as specialized olfactory organs, although both may play an important part in food discovery. The sense of sight is a minor factor in these reactions.

Numerous tests make clear that Palaemonetes is sensitive to chemical stimuli over the greater part of the surface of the body, and that it may exhibit remarkable differential response to localized stimulation.

The animal also senses food when the stimulating material is more dilute than in the cases cited, and gives indication of directive response.

The reactions recorded appear to depend on a diffused integumentary sense which, in certain respects at least, resembles more closely the olfactory sense of higher animals than either the gustatory or common chemical sense.

64. Sterility of animals under changed condition. (By title.) CARL HARTMAN, University of Texas.

Many animals are known not to mate in captivity; others are sterile in spite of matings. Sterility in the opossum due to atresia of the ovarian follicles has been encountered for some years, the proportion of cases increasing with the length of captivity. Normally the female opossum ovulates in absence of the male; conversely, the presence of the male does not (as in the rabbit) prevent atresia of the ripe or nearly ripe follicles.

In experimenting upon 65 females from March to May, 1922, an attempt was made to study the possible rôle of vitamines in the present instance (cf. Evans and Bishop, 1922). All animals received bread and skim milk; and certain groups received an addition of liberal quantities of whole milk, cod-liver oil, yeast or canned tomatoes, or combinations of them. Normal ovulation took place in certain individuals without regard to quantity or kinds of vitamine; in others super-abundance of fat soluble A, in combination with B and C, failed utterly to prevent or cure the atresia.

Finally six animals, all of which had been in dioestrum (epithelial cells in vaginal smear) for months, were allowed the free run of a room 8 x 20 feet. Four of these promptly ovulated. Though the number is small the result is in line with the observations of others that exercise favors fecundity.

As the animals were otherwise in apparently excellent health, the ovary appears to be the most delicate indicator of bodily dysfunction (cf. Stieve, 1918; Evans and Bishop, 1922).

65. The attachment of oyster larvae. (Lantern.) THURLOW C. NELSON, Rutgers College.

Mature oyster larvae were observed in the act of setting on a glass plate which had been suspended in a tidal creek containing oyster larvae at the setting stage. The larvae moved slowly about on the foot, describing circles of ever decreasing diameter, coming to rest after about 15 minutes with the ventral border of the left valve in contact with the glass. The foot, held in the median position, kept the shell in place while attachment was effected by bringing the secreting edge of the mantle border in contact with the glass. The circling of the larvae prior to attachment results in a strikingly even distribution of the attached spat.

66. The circus movements of Limulus. WILLIAM H. COLE, Lake Forest College.

Symmetric and asymmetric stimulations of Limuli (20–60 mm. diam.) have revealed positive phototropism and positive circus movements. The circle diameter and the light intensity are inversely proportional. Three intensities of non-directive, diffuse illumination were used, being approximately 8000, 2000, and 900 cm. In some animals the lateral and median eyes on one side were removed, and in others these eyes were covered by asphaltum. Under intensity I the mean turning per centimeter was 6°.73; under intensity II, 5°.23; under intensity III, 4°.78. These figures came from 133 experiments on 38 animals, selected because of their regular reactions. About 25 per cent of normal animals were irregular in their reactions, some being indifferent to light, others showing a mixture of positive and negative reactions, as might be supposed, since in many animals primitive tropisms are frequently modified or even obliterated by other reactions occurring simultaneously.

The inverse relation between light intensity and diameter of the circles in Limulus contributes further evidence to Loeb's heliotropism theory formulated in 1888. Under non-directive diffuse illumination the strength of the stimulus on the asymmetric photo-receptor remains practically constant during a single revolution, and all parts of the retina are equally stimulated, since the rays of light enter at all angles with the same intensity. This fact would vitiate any hypothesis based upon localized retinal stimulation in animals with eyes. The few exceptions to the tropism theory so far reported are undoubtedly due to the masking of the primitive tropistic reaction by other more complex reactions.

67. Effect of thyroid feeding on the color and form of the feathers of fowls. BENJAMIN HORNING and HARRY BEAL TORREY, University of Oregon.

Brown Leghorn chicks from the age of two weeks were given dried thyroid in daily doses proportionate to their size. In these birds the assumption of adult plumage, both as to form and color was delayed. The coloring of the birds, at the present time seven months old, still departs in certain definite respects from the normal. The general color is darker, owing to a marked increase in black pigment in hackles, shoulder, back and saddle feathers. The brilliant red characteristic of the normal hackles, back and saddle feathers is poorly developed or lacking, its place being taken in part by yellow. The hackles and saddle feathers show a sort of spotting near their ends, due to irregularities of the black central stripe that interrupt the continuity of the highly colored border.

The color change is associated typically with a structural change, the increase

in width of the dark central stripe being accompanied by a corresponding increase in the number and distribution of the barbules on the barbs.

68. The physiological response of Paramecium to thyroxin. MATTHEW C. RIDDLE and HARRY BEAL TORREY, University of Oregon.

The physiological response of Paramecium to the presence of thyroxin crystals in the culture medium is prompt and definite. The delay or lag which Kendall observes in vertebrates is absent.

The effect of the thyroxin is manifested especially in a slight decrease in the rate of division and a large increase in excretory activity. The average daily division rate calculated from observations on eighteen experimental cultures, under observation for periods ranging from seven to seventy-one days, was 0.8205 after thyroxin, 0.8587 in the controls. These figures represent a decrease of 4.54 per cent in division rate in the thryxoin cultures. This decrease is too small to be of little more than negative significance. It is in sharp contrast, however, with the large increase in division rate observed by Shumway in Paramecium fed with thyroid gland. The contrast suggests that factors other than thyroxin may be responsible for Shumway's results.

The acceleration of the excretory activity of Paramecium by thyroxin is indicated by an increased rate of pulsation of the contractile vacuoles, an increase in the number of accessory canals, and a great decrease in the number of excretory crystals in the endoplasm. These observations are in accord with those of Shumway and other investigators who have analyzed the response of Paramecium to thyroid gland.

Thyroxin appears to promote katabolic rather than anabolic processes, a view in accord with the idea advanced by Biedl that the active agent in the thyroid secretion is a dissimilatory hormone.

69. Excretion and death among amebas. A. A. SCHAEFFER, University of Tennessee.

The length of time that undigested remains of food are kept in the different species of amebas varies very greatly. Some species excrete undigestible materials within a half-hour or less, after feeding, and are consequently frequently seen without any recognizable food objects in them. Other species retain much if not all of the indigestible material indefinitely. Reproduction by division prevents the excessive accumulation of these materials in the body. The crystals, a by-product of metabolism, are also not excreted nor are they destroyed within the ameba. The excessive accumulation of these crystals is also prevented by division. But when the division rate slows down or when division ceases altogether, the inert materials accumulate until the ameba finally dies. These and other observations indicate that cells which excrete imperfectly will die if they do not divide.

70. The physiological action of excretory products. EDWARD F. ADOLPH, University of Pittsburgh.

It is usually assumed by biologists that the end-products of metabolism are toxic to the cells producing them. This is known to be true in metazoan cells for carbon dioxide and for acids in general, but not in green plant cells for oxygen. Are the nitrogenous excretory substances detrimental to animal tissues? The flatworm Phagocata lived for 24 hours or more in a 0.31 M urea solution, while Sucrose solu-

tions and Ringer's solution above 0.23 M are toxic, as are sodium chloride and other salt solutions of equivalent osmotic pressure. Gradual acclimatization led to survival in slightly higher concentrations. Paramecium lived for one hour or more in urea, sucrose, and salt solutions of 90 per cent of the above concentrations respectively. Uric acid and the most soluble neutral urates, monolithium and monopotassium form saturated solutions of insufficient concentration to have any physiological effect. Hearts of the newt Diemyctilus were immersed in Ringer's solution containing varying quantities of urea up to 0.28 M without measurable physiological detriment. A human subject ingested 45 grams of urea (0.65 grams per kilo) at a single dose without symptoms. The evidence thus accumulated fails to indicate that the urologist's uremia is due to urea, and that gout and other diseases are at all complicated by the presence of excessive amounts of urates in the organism. Either waste-products are not deleterious through their retarding of metabolism, or urea is not an excretory substance in Phagocata and Paramecium. Apparently all tissues can withstand any concentration of urea which is physically compatible, and the tissues of selachian fishes are not alone in their tolerance of this substance.

71. Eyes in Volvox and their function. S. O. Mast, Johns Hopkins University.

The eye-spots in Volvox consist of a brownish cup-shaped structure and a hyaline lens-shaped body. There is one in each zooid, some colonies containing as high as 22000. Those at the anterior are much larger than those at the posterior end of the colonies, varying from 3μ to less than 1μ in diameter. They are situated at the postero-lateral surface of the zooids and face postero-laterally.

The cup is transparent for the longer but opaque for the shorter waves. If direct sunlight is thrown into it the former (yellow, red) penetrate the wall and come to a focus near the convex surface while the latter (green, blue) are reflected by the inner surface of the cup and come to a focus between it and the lens. The region of maximum stimulating efficiency in the spectrum is in the green near the blue. The photosensitive substance is consequently probably located at the blue-green focal point, between the lens and the inner surface of the cup.

When the colonies are laterally illuminated, rotation on the long axis results in alternate decrease and increase in the intensity of the blue-green in the cup. The former causes an increase, the latter a decrease in the backward stroke of the flagella if the colonies are positive, and the opposite if they are negative. These responses are dependent upon time-rate of change in intensity. They are of the all-or-none or trigger type.

The eye-spots in Volvox function as direction eyes.

72. The growth of marine organisms on submerged metals. G. H. Parker, Harvard University.

Pieces of Al, Zn, Fe, Sn, Pb, and Cu were submerged in the sea and the growth of animals upon these metals was recorded. A general growth occurred on Al, Fe, Sn, and Pb, a very slight one on Zn, and none on Cu. Apparently marine animals will grow on any heavy metal provided that metal does not liberate ions or soluble compounds. The ions and soluble compounds of the heavy metals are usually extremely poisonous and where they are liberated freely from a metallic surface that surface is protected against organic growth. Such seems to be the case with Zn and

Cu. With Al, Fe, Sn, and Pb the products of marine corrosion are essentially insoluble and hence organisms grow on these metals in the sea. By coupling Cu with members higher in the electromotive series, this metal can be rendered chemically inactive in seawater and under such circumstances animals will grow freely upon it. Zn in this respect is much less easily controlled, for it lies high in the electromotive series and consequently it is not open to the electromotive protection that Cu is. Its compounds, moreover, are relatively freely soluble and thus become very effective in checking the growth of animals.

73. Relative effects on ciliary activity of anion and undissociated molecule of organic acids. J. M. D. Olmsted and J. W. MacArthur, University of Toronto.

The question has been raised as to the cause of the greater effectiveness of organic acids over inorganic acids of the same pH in inducing changes in certain physiological processes, *e.g.* the stopping of ciliary action. Both anion and undissociated molecule have been held responsible. To differentiate the effect of the anion from that of the molecule we have used combinations of acids and non-injurious salts, such as HCl + NaCl, HAcet + NaCl, HAcet + NaAcet, HCl + NaAcet, etc. The mixtures were in every case essentially isotonic throughout the entire pH range, thus eliminating the important osmotic factor. By taking into consideration the rôle of ionization in these combinations, it is possible to determine accurately the relative effects produced by the anion and the undissociated molecule. In the case of acetic acid the effect is evidently due preponderantly to the undissociated molecule.

74. On the nervous organization of Limax. W. J. Crozier, Rutgers College.

Reciprocal systems of muscles concerned with extension and retraction of the head and the mantle of *Limax maximus* have their normal actions completely reversed following suitable injection with strychnine. The sensitivity of the animal is so increased that gentle breathing upon it may suffice to elicit vigorous retraction of head and violent forward extension of mantle. Strychnine is in this respect unique among alkaloids tested. It does not influence local responses of the body wall. Its chief effect is probably upon the central ganglia, as in Chromodoris. Other neurophil substances likewise produce in Limax effects of highly specific quality, such that a number of neuromuscular elements in the motor system of the slug may be analytically separated. Thus nicotine, in Limax at the male phase, leads to complete extension of the intromittent organ. The results are useful toward an account of the nervous organization of gasteropods, and also for their bearing upon the specificity of nervous differentiation.

75. Concerning laws of locomotion in gasteropods. W. J. Crozier, Rutgers College.

An attempt to discover correlations among physical features of the creeping of Limax. Vlès has proposed equations connecting frequency of pedal waves, velocity of creeping, and the power to carry the body of the animal vertically. These expressions fail when observations from any single individual are studied, but they have a certain average validity when results from numbers of individuals are massed; their physical meaning is therefore obscure. When Limax creeps with pedal waves of a given conformation, the velocity of progression is proportional to wave frequency. But the efficiency of the single wave may be changed independently of the frequency.

76. Effect of thyroid feeding on the moulting of fowls. Benjamin Horning and Harry Beal Torrey, University of Oregon.

Brown Leghorn chicks were fed dried thyroid in doses progressively larger with increase of body weight, beginning with one-half grain two weeks after hatching.

One result was a striking alteration of the normal course of moulting. Customarily the first and second sets of rectrices are quite separate and distinct. In the thyroid fed birds, however, they are continuous. The feathers of the first set develop each with an abormally short vane, leaving the shaft naked for a longer distance than usual. Each feather is pushed out by what appears to be a feather of the second set, with which it is continuous. After remaining attached to the latter for a few days it breaks off, leaving the tip of the new feather frayed and ragged, but otherwise in form typical of the feathers of the normal second set.

Similar interference with the normal moult has been observed in other regions, notably in the wing coverts. The appearance of characteristically male plumage (*e.g.*, hackles and saddle feathers) is retarded several weeks in thyroid fed males. There is some evidence for the view that this retardation is not so pronounced in thyroid fed capons.

77. The reactions of larvae of Vanessa antiopa Linn. to sound. Dwight E. Minnich, University of Minnesota.

The full grown larvae of the mourning-cloak butterfly, *Vanessa antiopa* Linn., respond to certain sounds by contracting certain of the longitudinal muscles in such a manner that the anterior third of the body is thrown dorsally or dorso-laterally. Varying intensities of response may be elicited; from extremely violent jerks, produced by intense sounds, to barely visible retractions of the head, effected by stimuli near the threshold.

Trials with tones show a very definite upper threshold with respect to pitch. This threshold is between d″, 576 v.s., and b′, 480 v.s. Above this threshold even very intense tones seem to elicit responses from only occasional individuals, as a rule. Below this threshold, however, the caterpillars react regularly and vigorously down to and including tones of 32 v.s.

Mechanical vibration of the substrate does not effect the response in question, although a sudden sharp air current will. In contrast to a sudden jet of air, a continuous air current, even though gentle, will completely inhibit the response to sound.

The spines may be removed from the caterpillar without abolishing the response to sound. An attempt was made to eliminate the body hairs also, by means of singeing. The animals did not respond after this operation, but the violence of the procedure resulted in the death of all the animals except one within a few hours after the operation. Consequently, no conclusion may be drawn concerning the hairs until further work is done.

78. The process of photic orientation in Volvox. S. O. Mast, Johns Hopkins University.

The flagella in Volvox beat diagonally, resulting in locomotion and rotation on the long axis. If the illumination is suddenly reduced the flagella beat straight back for 1 to 3 seconds resulting in momentary cessation in rotation and increase in the rate of locomotion. If the illumination is increased the opposite occurs, locomotion

ceases momentarily and the rate of rotation increases. These responses do not occur if the illumination is gradually changed. They are consequently dependent upon the time-rate of change in luminous intensity.

In positive colonies, laterally illuminated, the flagella on the shaded side beat backward more effectively than those on the illuminated side resulting in turning toward the light (in negative colonies the reverse obtains).

In the zooids on the illuminated side of the colonies the light shines into the eye-cups and the photosensitive tissue is illuminated, in those on the shaded side this tissue is shaded by the wall of the cup, the amount of light it receives is consequently greatly reduced when, owing to rotation, the zooids proceed from the illuminated to the shaded side of the colonies, and greatly increased when they return. In positive colonies this results in increase in the backward stroke of the flagella on the former side and decrease on the latter side, and turning toward the light.

After the colonies are oriented and face the light directly the photosensitive tissue is no longer subjected to changes of intensity and they consequently proceed directly toward it.

79. On certain determining factors in regeneration. J. William Buchanan, Yale University. (Introduced by L. L. Woodruff.)

Concentration of chloretone that have been shown to be effective in controlling head frequency in pieces of *Planaria dorotocephala* when applied immediately after section during the period of stimulation, are also effective in controlling head frequency when applied after the stimulation of section has disappeared.

Concentrations of ether that are effective in controlling head frequency when applied immediately after section are *ineffective* in producing increases in heat frequency when applied after the stimulation of section has disappeared; only decreases in head frequency appear.

Measurements show that chloretone in the concentration and duration of exposure employed is an effective general protoplasmic lepressant; and that ether in the concentration and duration of exposure employed is not effective in producing general protoplasmic depression.

The facts indicate that the metabolically more active tissues of the developing anterior end recover more rapidly from the depressing effect of chloretone than do the less active tissues of the piece; this recovery while the remainder of the piece is still depressed tends to increase head frequency; that long continued exposure to the depressing action of chloretone so affects the young, highly susceptible tissues of the developing anterior end that recovery is incomplete; and tends to decrease head frequency; that no increases in head frequency appear after exposure to ether because this substance is not effective in depressing the metabolic activity of the old tissues of the piece; apparently only the highly susceptible tissues of the developing anterior end are appreciably affected; hence only decreases in head frequency appear.

80. Weight changes and oxygen consumption during long exposure to dilute anesthetics. J. William Buchanan. (Introduced by L. L. Woodruff.)

When individuals or pieces of *Planaria dorotocephala* are subjected continuously to mol.1/10 alcohol the oxygen consumption increases much more rapidly than that of control animals. With animals of moderate size the oxygen consumption in alcohol

at the end of six weeks is seven hundred per cent that of control animals. The susceptibility of the alcohol animals to lethal solutions of KNC is also markedly greater than that of control animals. The weight of the alcohol animals decreases only slightly more rapidly than that of the controls. The data suggest that the alcohol is oxidized with increasing rapidity by some intrinsic oxidative mechanism of the organism.

Subjecting animals to mol.1/3000 chloroform for two weeks or less induces slight increases in oxygen consumption over the control animals and greater decreases in weight. Subjecting the animals to mol.1/825 chloral hydrate induces greater increases in oxygen consumption than in the case of chloroform but not so great as in alcohol. The weight decreases more rapidly than that of control animals. Incomplete work indicates that long exposure to mol.1/1000 chloretone also induces an increase in oxygen consumption above that of controls and also that their weight decreases more rapidly. Similar experiments with mol.1/300 ether failed to show any effect of this concentration on oxygen consumption and decrease in weight. The data suggest that the normal respiratory metabolism is stimulated by these agents, and that alcohol and perhaps also chloral hydrate are oxidized by the organism.

81. Amoeboid movement and coalescence of dissociated sponge cells. PAUL S. GALTSOFF, U. S. Bureau of Fisheries. (Introduced by W. C. Allee.)

The examination of various sponges (Microciona, Cliona, Reniera, Halichondria, Grantia), made by the writer, shows that the coalescence of dissociated sponge cells occurs as a result of the aimless amoeboid movement of the archaeocytes moving in different directions and coalescing with cells which happen to lie in their route. The outer protoplasmic layer of archeocytes is sticky; this allows the cells to adhere to one another and to various objects which they meet in their route.

The coalescence of cells of two different species never occurs apparently because the physical properties of protoplasm of the various species are different.

The adhesiveness of protoplasm of Microciona cells may be increased by raising the alkalinity of water. In this case, when Microciona and Cliona cells are mixed together, the Microciona aggregates are surrounded by Cliona aggregates, the latter forming a ring closely attached to the former.

The presence of cells of another species mutually suppresses their amoeboid movement. Consequently the aggregates formed in a compound suspension are smaller and correspondingly more numerous.

The phenomenon of coalescence of dissociated sponge cells has a great resemblance to the agglutination of motile blood cells of Arthropoda. In both cases no chemotropic or "cytotropic" stimulus can be discovered and no such hypothesis is required to explain the results.

82. Reversal of vertebrate heart beat. JAMES NELSON GOWANLOCH, Wabash College. (Introduced by B. H. Grave.)

Striking and significant modifications of heart form and function can be produced in a teleost (*Macropodus viridi-auratus* Lacepede) by the action of various chemical and physical agents during early development. A differential inhibition or obliteration of the heart is possible, beginning at the sinus end and a graded series of forms

ranging from normality to complete absence of heart has been produced. Physiologically certain of the differentially inhibited, tubular hearts closely approximate the ascidian condition, groups of beats of conus origin alternating with groups of sinus origin. In other cases a continuous conus to sinus beat is established, constituting a complete reversal of the normal direction of beat. These modifications of form and function can be experimentally controlled to a very considerable degree and it seems entirely clear that the basis of such control of form and beat is an effect upon a graded differential in metabolic activity, and that, whatever may be the nervous or muscular mechanisms of integration in the definitive heart form, its primary integration is due to no such mechanisms, but to a fundamental gradient in metabolism with low end at the conus and high end at the sinus. The results of this work are in complete agreement with, and constitute further evidence in support of the axial gradient conception.

83. Observations on the ciliary action of Scyphidia. Ruth Jane Ball, University of Vermont. (Introduced by H. F. Perkins.)

There are four distinct groups of cilia in Scyphidia: a single row of fine discal cilia; two groups of setaceous appendages at opposite points on the disc; two long curved "vestibular setae" attached to the lower side of the gullet; and the fine cilia of the gullet. The discal cilia bring particles to the peristome border. Their movement is not constant and is controlled by the two groups of setaceous appendages that move by a characteristic "twitching." The fine cilia of the gullet are constantly in motion. Their direction of beat is often reversed. The "vestibular setae" aid in pushing away solid contents of extruded food vacuoles and in capturing large particles. A detailed study of each group has been made. Illustrations and a discussion of each group, with especial reference to ingestion and rejection of food and foreign particles.

84. The effect of temperature upon the rate of retinal pigment migration in crustaceans. Rudolf Bennitt. (Introduced by G. H. Parker.)

Dark-adapted Gammarus were subjected to different constant temperatures, the duration of the distal pigment migration induced by light being found by killing and sectioning individuals at successive stages during exposure to light. The duration of the proximal migration induced by darkness was similarly determined in light-adapted Gammarus. In both migrations, the curve of temperature against rate follows closely that of Vant Hoff's Law of the relation of temperature to rate of chemical processes. Retinal pigment migration is hence a biochemical, rather than a physical, process, and is based upon protoplasmic streaming within the retinal cells.

85. The feeding reactions of the ciliate, Dileptus gigas, with special reference to the function of the trichocysts. J. Paul Visscher, Johns Hopkins University. (Introduced by S. O. Mast.)

Dileptus gigas normally feeds on living organisms. It discriminates between living organisms and inanimate substances, ingesting the former in large amounts while the latter are only sparingly ingested. It selects from among the different kinds of organisms, eating some with great readiness while others are rarely ingested. It captures its prey by means of trichocysts which are embedded in a groove on the

oral surface of the proboscis, forming a median band extending from the tip posteriorly to the mouth. These trichocysts either paralyze the prey or cause cytolysis of its protoplasm. They are probably of a liquid nature, highly toxic, with specific cytolytic properties. They are sac-like structures whose contents remain liquid after they are discharged. For this reason the term toxicyst is suggested instead of the term trichocyst.

Selection of food in Dileptus is dependant on two factors; first, the physiological state of the organism, which determines whether a substance shall be ingested in large or small amounts; and second, the chemical properties of its trichocysts, which in relation to the properties of the protoplasm of its prey, determine in large measure whether a living organism can or can not be successfully captured. Specialized structures as for example, the trichocysts of Paramecium and the lorica of Euplotes, serve as protection against the attacks of Dileptus. The power to select food in Dileptus is dependent on physical and chemical factors.

H. ECOLOGY AND ZOOGEOGRAPHY

88. Quantitative aspects of association and of seasonal succession in an artificial environment. W. J. Crozier and E. S. Harris, Rutgers College.

Enumerations made of the animals inhabiting a sewage "filter," of intermittent sprinkling type, disclose an association of some 50 genera preadapted to this essentially artificial environment. Protozoans, nematodes, rotifers, and oligochaetes are the conspicuous animal constituents of an organized film upon the stones of the "filter," the density of the population being so great that in each (centrifuged) cubic centimeter of this material there are present an average of about 100,000 protozoans, 35,000 nematodes, 4,000 rotifers and 150 annelids.

Seasonal fluctuation and succession of these forms has been followed quantitatively by means of periodic sampling at four levels of the "filter," at intervals of about two weeks for a period of more than a year. To some extent variations in the fauna may be perhaps directly correlated with known environmental factors; other cyclic fluctuations arise rather as mechanical consequences of the self-regulating changes of the "film" as a whole. With reference both to the individual forms concerned and to the cyclic adjustment of the whole film which is an expression of their integrated activities, the results are important for the theory of adaptation applying to this large-scale experiment involving the peopling of a novel environment.

89. Some myriapods of South Bass Island, Ohio. Stephen R. Williams, Miami University.

For the past three years a single colony of Pauropus huxleyi (?) has been found by a log in a woods near the Ohio State Fish Hatchery, Put-in-Bay.

With the Pauropus a single individual of Eurypauropus spinosus (Ryder) has been obtained. This extends the range of this species northward and westward from Gambier, Ohio, where it has been reported by Profesor Walton.

Scutigerella immaculata, usually very scarce, was in some abundance in the early part of the 1922 season.

Larval Scytonotus have been found for many summers but none mature enough to show sex organs.

In spite of the abundance of rocks, Scutigera, the house centipede has not been found on the island. It is on the peninsula of Marblehead ten miles away.

90. American Opalinidae. MAYNARD M. METCALF.

This paper lists the genera and species of Opalinids known from twelve regions of the western hemisphere which are somewhat demarcated zoögeographically; directs attention to the affinities of these species; and discusses briefly the significance of this affinities as indicating sources of origin and routes of spreading of the ancestors of the American Opalinids. The data have paleogeographic significance. Charts are used in illustration.

91. The alternative color-phases of fishes. (Lantern.) W. H. LONGLEY, Goucher College.

Characteristic changes in coloration are induced in many tropical fishes by changes in their relation to their environment, or by changes in its character, as they pass from place to place. The conditions under which alternative phases are displayed in a number of species will be illustrated. The obliterative effect of the coloration will be more clearly indicated than in pictures previously exhibited. A few slides without particular reference to the main thesis, but illustrating further the possibility of successful marine photography, will be shown.

92. Further observations on the hydrogen-ion concentration of Chesapeake Bay water. R. P. COWLES, The Johns Hopkins University, and A. M. SCHWITALLA, St. Louis University.

The determination of the pH values for the Chesapeake Bay water has been continued, and forms a part of the procedure followed in a biological and hydrographic survey of that body of water for the U. S. Bureau of Fisheries. Observations have been made at a station near the center of the bay off the mouth of the Potomac River and this station has now been visited in June 1921, January 1922, and March 1922. On all three occasions the pH values have been determined from samples taken at the surface, 10 meters, 20 meters, 30 meters and the bottom at one and a half hour intervals for twenty-four hours.

In January there was almost no variation in the pH values from the surface to the bottom and little indication of diurnal variation. March observations showed a distinct decrease in pH values, i.e. a decrease in alkalinity, passing from the surface to the bottom and in general a decrease in pH values during the night and early morning. The June observations at all hours showed the largest decrease in pH value passing from the surface to the bottom a maximum of 8.1 at the surface and a minimum of 7.2 at the bottom. Diurnal variation was quite evident, especially at the lower depths.

93. The bibliography of fishes. E. W. GUDGER, American Museum of Natural History.

This work owes its inception and approaching completion to the vision, energy and enthusiasm of Dr. Bashford Dean and his associates. Volumes I and II, begun by Dr. Dean many years ago and carried to completion by the late Dr. C. R. Eastman, contain 36,000 titles of articles and books pertaining to fishes. Volume III, on which I have collaborated with Dr. Dean, contains an Addendum of 4400 titles

plus 2300 Pre-Linnæan titles, (i.e. *ante* 1758), various small sections of bibliographies, voyages, and travels, etc., an extended and highly analytical subject-catalogue, and an index to this latter.

The Subject-Catalogue, which is mainly the work of Mr. A. W. Henn, has its morphological and general part divided into 118 sections beginning with Abdominal Pores, and ending with Vision in Fishes. Here the vast literature of fishes is brought into logical order, identical subjects are grouped and surrounded by their likes. The second part of this Subject Catalogue contains the less analytical natural history subjects, distribution papers, the larger taxonomic papers, etc.,—i.e., those subjects wherein the species is the unit.

There will be an ordinary alphabetical index to the Subject Catalogue which will enable one to find not merely a large section, as Nervous System, but any subsection under this heading, as Optic Chiasma, Ependyma, Reissner's Fibre, etc.

The printing of the final parts may be expected by next summer and the completion of this work, which will bring to the student of fishes the whole literature on any minute and obscure subject, ought to be a tremendous factor in furthering the study of fishes.

94. The effect of environmental conditions on the rate of development. (Lantern.) A. O. Weese, James Millikin University.

Cocoons of *Epeira gibberosa* (?), some of which were parasitized by *Arachnophaga picea* Riley were subjected to controlled atmospheric conditions, with results leading to the following conclusions:

1) High temperature and high relative humidity caused most rapid development of the spiders, but mortality was lowest under outdoor conditions, and spiders were unable to complete development or to emerge except under conditions of high humidity. 2) The parasites developed most rapidly when subjected first to freezing temperature, then to low temperature and low humidity, and finally to high temperature and high humidity. Mortality was greatest under outdoor conditions, and least when the cocoons were kept at high temperature and moderate or low humidity. 3) The threshold of development of the parasite was found to be lower than that of the host, but the latter developed more rapidly at high temperatures. 4) It was found possible to compute relative velocity factors for each set of conditions and to produce an approximate constant by their summation.

95. Studies of animal aggregations: The temperature relation with isopods. W. C. Allee, The University of Chicago.

Temperature is not the controlling factor in the formation of aggregations of either land or fresh water isopods under laboratory conditions, but does modify the tendency to form bunches.

With the fresh water isopod, *Asellus*, the general tendency to collect in closely knit bunches decreases with the passing of the breeding season and conditions which favor the formation of aggregations in April have little or no effect in late May.

Isopods placed in uniform temperature even at the height of the breeding season lose their tendency to form these aggregates in from one to five days. This reversal in the bunching reaction occurs more rapidly at higher than at lower temperatures. After such isopods have lost all tendency to form collections, either an increase or a decrease in temperature will restore the tendency.

In so far as they have been tested, similar results have been obtained with two species of land isopods and it is possible that some such temperature relation is of widespread occurrence among animals that may live more or less singly or may gather into flocks or other aggregations at certain seasons of the year.

96. The tadpoles of the frogs of Okefinokee Swamp, Georgia. A. H. Wright and A. A. Wright.

We have studied seventeen species in the swamp and in its outskirts. Eggs laid singly. *Hyla squirella*—bodies greenish, tail uniformly sprinkled with black dots; *Acris gryllus*—very long, black-tipped tails and projecting spiracular tube; *Pseudacris ocularis*—scattered distinct black dots on body, black band on musculature of tail, clear intervals between musculature and rims of the crests; *Hyla gratiosa*—beautiful green tadpoles, deep crests, young with black saddles on base of the tail, light line from eye to tail. Eggs laid in films. *Gastrophryne carolinensis*—black, flat tadpoles, neither mandibles, nor labia, nor labial teeth nor fringes, the spiracle median and just ahead of the anus; *Hyla cinerea*—greenish tadpoles, yellowish tails; *Hyla femoralis*—some red, and five bands on the tail; *Rana grylio*—with a black-banded bordered pinkish vinaceous band on tail, and a black line through middle of upper crest; *Rana sp.*—black-rimmed and black-banded tail, bluish venter, dorsum with greenish yellow flecks. Eggs in lumps. *Rana virgatipes*—material not yet studied; *R. aesopus*—tadpoles greenish, four series of spots on dorsum, tail with large spots; *R. sphenocephala*—tadpoles like those of *R. pipiens*. Eggs in bands, later cylinders. *Scaphiopus holbrookii*—has bronzy tadpoles, translucent crests, rounded tail tip, oblique black bars on musculature; labial teeth 4/5. Eggs in files. *Bufo quercicus*—gray tadpoles, six or seven black saddles on musculature, heavily marked upper crest, venter one mass of color; *Bufo terrestris*—black tadpoles, upper crest less spotted, venter not one mass of color.

97. A morphological mechanism in some instances of physico-chemical adaptation. F. H. Pike, Columbia University.

It has been argued that, since some instances of adaptation may be explained on a physico-chemical basis, they can not have arisen in organic evolution. It might be said further that natural selection can not have been operative in their presentation. A closer study of these cases is necessary before accepting such a conclusion.

The demonstration of the necessity for, and the actual participation in these physico-chemical processes of adaptation, of a structural or morphological mechanism which has definitely arisen in the course of organic evolution would change the complexion of this question. I have called attention to two such cases. In the reaction of a higher organism (dog) to variations in external temperature, the whole organism follows the principle of le Chatelier and Braun. A poikilothermalanimal does not react in this way. (Rubner.) The reason for the difference in the reactions of the two types of animals to the same change in the external environment is to be sought in the development of a morphological mechanism in organic evolution. In my studies on the reactions of the central (nervous) respiratory mechanism, under varying conditions of blood supply, the application of the principle of le Chatelier and Braun has also been shown. Here also the reactions of the animal is dependent upon a morphological mechanism which has arisen in organic evolution.

I. GENETICS SECTIONS

102. The transmission of the polycladous character in Sphaerocarpos Donnellii. CHARLES E. ALLEN, University of Wisconsin.

The 'polycladous' clones, derived from two aberrant male plants, probably of common origin, which appeared in a culture of *S. Donnellii*, are distinguished by: crowded, markedly irregular lateral lobes; antheridia few, often lacking in considerable regions, naked or subtended by lateral leaf-like, lacerate, or ciliate involucres; occasional cup-shaped or approximately tubular involucres, rarely approaching the typical form; numerous dorsal lobes and cilia, some of which may represent involucres.

Typical ♀ × polycladous ♂ gave:

	Typ.	Polycl.	Doubtful	Undet.
♀	45	32	1	
♂	28	21		
Sex undet. (died young)		5		5

Polycladous females have the vegetative characters of polycladous males; also dorsal columnar upgrowths, which may represent involucres; so far as dissection has shown, they lack archegonia, and attempts at fertilization have been uniformly without result. A few clones show rare involucres approaching the typical form, and one clone bears at times a considerable proportion of such involucres. Cytological study by Mr. A. M. Wolfson shows that they possess the chromosome group characteristic of typical females, the polycladous males having the chromosomes characteristic of typical males. The "doubtful female" is possibly an intermediate form.

A cross of a polycladous male with a tufted female ("tuftedness" being a variable character apparently inherited in different degrees by the offspring of a single cross) gave:

	Type. to Tufted (Not Polycl.)	Polycl.	Doubtful	Undet.
♀	16	10		1
♂	8	7	1	1 (?)
Sex undet. (died young)				10

The aberrancies characteristic of tufted races would be masked by those of the polycladous form; probably the tufted potentiality is inherited by some of the polycladous offspring.

103. Color changes in maize pericarp and the nature of the gene. WILLIAM H. EYSTER, University of Missouri.

This paper is concerned with a dilute red pericarp which changes to more dilute reds and colorless as well as to more intense reds. There are frequent changes also to a number of variegations which also are unstable. The variegations change to reds of different intensities and to colorless. Colorless types thus originated appear fixed, while the deep reds are fairly stable.

The gene for these color changes is one of a large series of multiple allelomorphs for pericarp color in maize. It is usually quite stable until late in ontogeny when it

becomes unstabilized and changes with surprising frequency. From the nature and frequency of the color changes it is concluded that the gene is a complex structure composed of opposing gene elements. When the gene loses its stability late in ontogeny like elements are mutually attracted, while unlike ones are repelled. Consequently mitotic divisions will occur which will partially or completely separate the opposing elements and a variegation will result.

Variegation in pericarp color, flower color, in chlorophyl distribution, and the like, is the result of a gene changing from unstable to stable conditions.

104. Inheritance of a primitive sporophyte in maize. William H. Eyster, University of Missouri.

In the Spermatophytes the fertilized egg develops immediately into a sporophyte which becomes dormant while still in an embryonic stage. Such an embryonic sporophyte with the surrounding tissues is called a seed. This paper is concerned with a maize sporophyte which fails to enter the dormant state, but continues its development uninterruptedly from the fertilized egg to the plant. This characteristic behaves like a simple mendelian recessive character, and is linked with a factor for pale yellow endosperm with about 1.25 per cent crossing over, and a factor for chlorophyll development.

105. Notes on heritable endosperm defects of maize. E. W. Lindstrom, Iowa State College.

Two new types of heritable defects of corn endosperm have occurred over a period of three years. Three inbred generations of a commercial strain of Golden Bantam sweet corn afford conclusive data on the Mendelian inheritance of a simple, recessive endosperm-defect.

A similar result was obtained with a strain of Yellow Flint corn. This recessive defect, however, proved to be completely linked in inheritance with the pure white or albino seedling character.

106. Eight years selection for quality of oil in soy beans. L. J. Cole, E. W. Lindstrom and C. M. Woodworth.

Beginning in 1912 with a single plant, high and low selection for drying quality of soy bean oil was practised for eight years. A significant separation of the two selection lines occurred, the high line showing a slight upward tendency and the low line a distinct downward trend. These results are interpreted as due to the isolation of different genotypes from an original mixture.

A distinct correlation between drying quality of oil and season of maturity was found. The high line proved to be distinctly later and of a different type of growth than the low line.

A slight negative correlation was found to exist between quality and percentage of oil. This was so small as to be of no commercial importance.

107. The relation between chromosome number and morphological characters in wheat hybrids. Karl Sax, Maine Agricultural Experiment Station.

A cross of *Triticum vulgare*, with 21 haploid chromosomes, × *T. durum* with 14 haploid chromosomes resulted in partially sterile F_1 plants and an F_2 population

with all degrees of sterility. Chromosome counts of 46 F_3 plants showed 21 with 14 haploid chromosomes, 12 and 21 chromosomes and 13 plants with an intermediate chromosome number. In the F_2 and F_3 the individuals with intermediate chromosome numbers are rapidly eliminated due to sterility and it appears that the ultimate homozygous fertile segregates will have either 14 or 21 chromosomes. A high degree of correlation was found between chromosome number, morphological characters, and rust resistance. All of the F_3 plants with 14 chromosomes had the distinguishing characters and rust resistance of the durum parent while all of the F_3 plants with 21 haploid chromosomes had the morphological characters and susceptibility to rust of the vulgare parent. Cytological and genetic evidence indicates that the characters which distinguish the *vulgare* varieties from the *durum* and Emmer varieties are due to the 7 additional chromosomes of the vulgare varieties. The unpromising prospects of combining the desirable characters of the durum wheats with the high quality of gluten of the vulgare wheats are obvious.

111. Anatomical differences between the various chromosome mutants of Datura. E. W. Sinnott and A. F. Blakeslee.

A study of the minute anatomy of the various chromosome mutants of Datura makes it evident that each of these mutants, heretofore recognizable only through external characters, is also readily distinguishable internally. The structure of the floral peduncle was found to be the most favorable region in which to observe these distinctions. Mutants differ markedly in number, width and depth of vascular bundles, in development of interfascicular cambium, in width of bast, in character of pericycle and in other ways. The addition of an extra chromosome in one of the pairs thus changes radically the whole internal and external structure of the plant. The so-called "acolytes" were found to show marked resemblances to their respective "apostles." The normal diploid plant is intermediate in its anatomical characters between the extremes shown by the mutants.

118. Factors which determine otocephaly in guinea pigs. Sewall Wright, U. S. Department of Agriculture.

Among some 40,000 guinea pigs in the genetical experiments of the Bureau of Animal Industry, 82 monsters of the otocephalic type have been recorded. They may be classified in a practically linear series of 12 grades of defectiveness, culminating in an almost headless condition. These grades may be interpreted in harmony with Child's gradient theory.

The majority (50) have appeared in one vigorous inbred family. There are marked differences among sublines of this family. Several produce 1 to 4 per cent, one produces over 20 per cent.

While there are important genetic differences between different families and subfamilies, the occurrence of the monsters can not be explained as due to Mendelian segregation or by mutation, except where one whole subfamily becomes differentiated in its tendency. Evidence indicates that the character is not maternal and that it is not a specific effect of inbreeding. Females are twice as likely to be affected as males.

There is a tendency, but a very slight one, for otocephali to be bred under unfavorable conditions; as indicated by month of birth, size of litter, weight and mortality

of littermates. The main factor must be one which affects the individual, not the litter.

By elimination it is concluded that the main factor is probably chance delay or other irregularity in implantation (as suggested by Mall) acting in conjunction with genetic factors which have a general influence on the metabolic level at a particular critical moment in development.

119. Persistent new color patterns in grouse locusts by mutation, and linkage, or homozygosis, with isolation. ROBERT K. NABOURS, Kansas Agricultural College.

There has been at least one mutation among the *Paratettix texanus* individuals reared in the laboratory. This one has bred true for seven years, through twenty-five generations, and numerous combinations from which it has invariably segregated according to Mendelian expectation. It has lately been placed in nature, and although not yet recovered, indications point to its survival as well as any others.

Numerous combinations of dominant patterns have been produced in *Apotettix eurycephalus* by linkage of factors in one series, or on one pair of chromosomes, and others by developing individuals (*P. texanus*) homozygous for two, or three patterns, the factors probably being located in different series, or on different pairs of chromosomes. It is possible, in fact, likely, that individuals homozygous for the patterns of these combinations might become isolated and persist till the normal (wild?) and elementary patterns, which would disrupt the combination, become extinct, at least in the adjacent territory.

120. The consequences of different degrees of interference, in the crossing-over of the hereditary genes. H. S. JENNINGS, Johns Hopkins University.

The paper gives the general results of a mathematical study of the relations exhibited in the so called crossing over of the genes, and compares these with those bound to occur if the genes are arranged in series and there is interference between breaks at points near together in the series. The observed ratios fall into a peculiar and complex system; by means of a mathematical formula it is shown that this entire system, even to details, is, in all essentials, a necessary result of the serial arrangement with a certain extent of interference. The marked changes that would result from different extents of interference are likewise shown.

121. Coincidence of crossing over in Drosophila virilis. ALEXANDER WEINSTEIN, Johns Hopkins University. (Introduced by H. S. Jennings.)

Crosses involving practically the entire length of the X chromosome in *Drosophila virilis* (over 92 units) indicate that coincidence is low for regions close together and that, as the intermediate distance becomes longer, coincidence first increases and then decreases. Coincidence is at a maximum (about 1.0) when the intermediate distance is about half the length of the chromosome. Therefore there is no interference between crossing over at the center of the chromosome and crossing over at either end; and, as might be expected, triple crossing over involving the center and both ends simultaneously is not interfered with, the coincidence being almost 1.0. As is to be expected from the greater genetic length of the *virilis* X chromosome, the total frequency of triple crossing over is greater than in *D. melanogaster*, and quadruple

crossing over (to the extent of about 0.2 per cent) occurs about as frequently as triple crossing over in *melanogaster*.

122. Notes on the pigment cells in the eyes of Drosophila eye-color mutants. O. A. JOHANNSEN, Cornell University.

Forms examined: Eosine miniature, eosin vermilion, pink, purple, ruby, sepia, tinged, vermilion, white, wild.

The eye structure, including cornea, pseudocone, retinulae, rhabdome and pigment cells, does not differ materially in the nine eye-color mutants from that of the wild fly Drosphila melanogaster. The pigment cells are present in all, though the pigment granules are wanting in white, and in the male of Eosin miniature, and but feebly represented in Eosin miniature, female, Eosin vermilion, pink and tinged. In all cases the most distinct coloring is found in the cells in the distal part of the post retinal fibre layer. In the more deeply colored eyes, purple, ruby, sepia, and wild, the proximal part of the accessory or basal pigment cells are, next to the post retinal cells, most deeply colored. The distribution of the pigment granules from the base of the pseudocone nearly to the basal membrane is rather uniform, though quite sparse in the paler colored mutants. Chemically, the eye color offers some interesting features.

123. Analysis of "Contamination" in Habrobracon. P. W. WHITING, University of Iowa.

In stock with defective veins, r_4, selection for eight generations has no effect. Percentage of defectives fluctuated about 95 and mean grade of defectives about 6.5. Defective males were mated to normal stock females and sons were bred parthenogenetically from their heterozygous daughters. A few of the most defective sons were again crossed to normal and this alternation of sexual and parthenogenetic generations continued to F_{23}. If defective differs from normal by one factor, d, the parthenogenetic segregating generations should consist genetically of one normal, D, to one defective, d, the latter showing 95 per cent defectives with mean grade 6.5. But defectives were only 85 per cent of one-half the total with 5.9 as mean grade. This "contamination" appeared in first segregating generation, F_2, and was not increased by thirteen subsequent crosses to the same normal stock. Pure defective stock isolated at the end of this series immediately reverted to original condition, showing "contamination" not permanent. Modifying factor, m, increasing percentage and grade of defectives was not lost for males with highest defect were selected for crossing from each segregating generation. Hypothesis is suggested that segregating generations consist of normal, 1 DM, 1 Dm, and genetically defective, 1 dM (75 per cent somatically defective with mean grade, 5.3), 1 dm (95 per cent somatically defective with mean grade 6.5). Attempt is now being made to derive theoretical stock, dM, showing 75 per cent defectives with mean grade, 5.3.

124. Facts indicating abnormal fertilization in Habrobracon. ANNA R. WHITING and P. W. WHITING.

When black-eyed males are crossed with orange-eyed females, orange males and black females are expected by sex-linkoid inheritance. A few black males, however,

appear. These patroclinous males represent seven-tenths of one per cent of the fertilized eggs that come to maturity. The remainder are females. From the reciprocal cross, orange male by black female, all normal offspring should be black. Patroclinous males in this case would be orange. Among 3824 black males and 2536 black females there was but one orange, a misshapen male which died as a pupa. Some patroclinous black males are weak, others die as naked pupae. Some appear to be retarded in development. Many, however, appear normal and mate readily. Mating tests divide these into three classes; the largest, sterile; a second slightly fertile; and a third of normal fertility. Daughters from second class tend to be morphologically defective and sterile, from third class normal in appearance and fertility. Patroclinous males transmit either their paternal or their maternal eye color, but in one case both black and orange daughters were produced from the same male. In normal stocks offspring, male and female, of mated females total from one-fourth to one-third fewer than offspring, male, of unmated females. These facts indicate that normal development is hindered by abnormal fertilization. The morphological defects and sterility of daughters of patroclinous males indicate injury to germ plasm.

125. The birth rate among the graduates of Allegheny college. H. R. Hunt, University of Mississippi.

Mental capacity is probably to a considerable extent inheritable. It is therefore important to determine whether the birth rate is tending toward a relative decrease in the number of intellectually superior persons. College graduates as a whole are probably inherently superior mentally to the population at large, yet recent investigations show that they produce relatively few children.

The following data were collected by questionnaires from the men and women who graduated from Allegheny College from 1870–1899. 316 (57 per cent) of the surviving graduates filled out the questionnaires. Of the 290 men, 11 per cent of those in the classes of 1870–1884 remained single, and 13 per cent in the classes of 1885–1899. The average sizes of completed families for these two periods are $3.19 + .18$, and $2.83 + .13$ children, respectively. The difference, $.36 + .22$, is probably not significant.

The married men and women graduates, plus their consorts, and the unmarried graduates total 632. This group produced 752 children. Life insurance statistics show that only about 588 (93 per cent of 632) of these children will probably reach maturity (21 years). When families with wives less than 45 years old are excluded, and the number of unmarried persons is reduced in proportion, the 632 is diminished to 425. Of the 531 children of this group, 415 (98 per cent of 425) will probably survive at least 21 years. It is therefore probable that this collegiate group has not more than replaced itself.

126. Sex-ratios in guinea-pigs. (Lantern, 10 min.) Heman L. Ibsen and Luella Schaumburg, Kansas State Agricultural College.

Out of a total number of 7989 guinea-pigs produced during the years 1913 to 1921 inclusive, 4128 were found to be males and 3861 females, making a sex-ratio of 106.92 (51.67 per cent) males to 100 (48.33 per cent) females.

Contrary to results reported by Papanicolaou (1921), no significant difference was found in the sex-ratios of animals belonging to litters of one size as compared

with those of other sizes. By similar methods it was determined that the sex-ratio for animals born in a particular month was not significantly different from that of animals born during any other month.

There seems to be no differential sex mortality. This is true of 320 still-born animals and of 485 others that died before they were 20 days of age. In neither case was the sex-ratio of the dead animals appreciably different from that of the complete litters from which these animals came.

When the age in months of the mothers at parturition was taken into consideration, some rather unexpected results were obtained. For instance, females 15 months of age gave birth to 145 males and 87 females, while females 8 months of age produced 192 males and 224 female offspring. The difference in percentage of males between these two cases is 6.06 times the probable error of their differences, i.e., if the above difference were entirely due to chance it would be likely to occur only once in 20,000 trials.

127. An environmental factor causing variation in weight at birth of guinea-pigs. (Lantern, 10 min.) HEMAN L. IBSEN, Kansas State Agricultural College.

In guinea-pigs the modal gestation period is 68 days and the average weight at birth approximately 85 gms. The live weight at birth ranges from 35 gms. to 145 gms. The average weight of foetuses from females pregnant 65 to 67 days depends upon the number of young in the uterus, as is shown by the following table:

Days in Uterus	Number of foetuses in uterus							Number of Litters
	1	2	3	4	5	6	7	
65	109.2	91.0	90.06	72.67	73.78	65.54	62.51	37
66		92.52	88.70	80.90	77.04	73.34		8
67			103.27	94.10				3

This table points to the possibility that crowding in the uterus tends to decrease the weight at birth. Other facts bear this out. It has been found that there is a fairly high correlation between the total distance on either side of a placenta and the weight of the placenta. For the 65 day stage the correlation coefficient is .4623 $\pm$ .0634, and for the 66, 67, and 68 day stages combined it is .6137 $\pm$ .0743. For the 65 day stage the correlation coefficient of weight of placenta and weight of attached foetus is .7578 $\pm$ .0246 and for the following three days combined it is .7764 $\pm$ .0404. The weight of the placenta thus varies directly with the amount of space on either side of it, and at the same time the foetus weight is highly correlated with the weight of the placenta to which it is attached. It seems probable that the effect of crowding upon foetuses is indirect, influencing first the placenta and secondarily the foetuses.

128. A brief description of abnormalities observed in the descendants of X-rayed mice. C. C. LITTLE, University of Maine, H. J. BAGG, Memorial Hospital, New York.

Among the F_2–F_3 descendants of mice given a light dosage of X-rays, a large number of individuals of the following types have appeared.

1. General head abnormality (lethal) resulting in the single or combined appearance of the following characters: (a) Absence of all trace of one or both eyes, (b) Hypertrophy or under development of the tongue, (c) Reduction or absence of the

lower jaw or of the mouth opening, (d) General reduction in body size and vigor (50+ cases).

2. Eye abnormality: a dry, crusted, hemorrhagic lesion involving the iris or whole eye on one or both sides producing typically blindness, but in rare cases approaching and overlapping normal. (300+ cases).

3. Deformities of any or all feet or legs, in some cases involving brachydactyly, in others syndactyly, and in some both. Curvature and marked distortion is often found. (25+ cases).

4. Dry, hemorrhagic lesion of the type listed under (2) resulting in absence of cranium and in dead acraniate monsters (5+ cases).

5. Dry, hemorrhagic lesion over lumbar region of spine resembling roughly, spina bifida (1 case).

6. Shortened hair on the flanks and sides (where hooded rats are white) normal hair on anterior end of body and on mid-dorsal stripe down back (in region where hooded rats of Castle's Grade +2 or +2½ are pigmented. (10+ cases.)

129. The inheritance of an eye-abnormality appearing among the descendants of X-rayed mice. C. C. Little, University of Maine, H. J. Bagg, Memorial Hospital, New York.

A pair of mice female 85 Brown and male 49 Brown were given one-fifth erythemal dose of X-rays on five successive days. Among their F_3, F_4, F_5, F_6, and F_7, descendants more than 300 abnormal young have appeared. The abnormality which in rare cases overlaps normal somatically is a dried, crusted, hemorrhagic lesion of one or both eyes. It is clearly a mendelizing character and is recessive to normal. Its inheritance has been tested not only by matings within the X-rayed lines but by an outcross and by its transmission through the male only.

130. The inheritance of a lethal head abnormality appearing among the descendants of X-rayed mice. C. C. Little, University of Maine, H. J. Bagg, Memorial Hospital, New York.

A pair of mice female 84 Brown, and male 36 Brown, were given one-fifth erythemal dose of X-Rays on five successive days. Among their F_2, F_3, F_4 descendants a considerable number of abnormal young have appeared.

In the abnormality studied, the characters affected may be the eyes (one or both) the mouth (jaws, tongue) and the general size and vitality. The abormality is lethal, resulting in the death of a great majority of the animals possessing it at birth, or during the first day.

The abnormality appears in proportions indicating strongly that it is due to a mendelizing gene and is recessive in nature.

In crosses of DD × DR, or DD × DD, sixty-one normal, and no abnormal have been obtained.

In crosses of DR × DR, the numbers obtained are 54 normal, 19 abnormal, the expectation on a 3 : 1 basis would be 55 to 18.

The abnormality has now been inherited in this way to the F_4 generation from the mice which were given the X-ray exposure.

131. A report of a histological study of the eyes and gonads of mice treated with a light dosage of X-rays. L. H. Snyder, Carnegie Institution, M. Schneider, Carnegie Institution, C. C. Little, University of Maine.

Mice were given a dosage of X-rays similar to that given the ancestors of the abnormal mice referred to by Little and Bagg in papers given in this program, and the histological appearance of their eyes and gonads were studied. No differences between the treated and untreated animals were found, and the conclusion is therefore that the chances favor the interpretation that the inherited abnormalities above referred to are in the nature of a direct effect of the X-rays upon the hereditary material underlying the characters involved.

132. The production of non-disjunction by X-rays and the hereditary transmission through untreated females of the XXY condition so produced. James W. Mavor, Union College.

In a previous communication the writer described what he called at the time the "elimination" of the X chromosome by X-rays. Further investigation has shown that the X-rays produce non-disjunction by which exceptional females as well as exceptional males are produced. A considerable number of exceptional daughters have been obtained after submitting the mothers to X rays before mating. A large proportion of these exceptional daughters have been found to be fertile and have bred further exceptions without having been submitted to X rays. The data establishes that the exceptional condition (XXY) produced as a result of treating mothers with X rays is hereditarily transmitted. Equational non-disjunction has also been produced by X rays and the XXY condition of this case transmitted through untreated daughters. The experiments have shown that X rays may produce a specific modification of the hereditary mechanism which is inherited as such.

133. The effects of X-rays on the albino rat. Frank Blair Hanson, Washington University.

One hundred and thirty rats, both males and females, were exposed for varying periods of time to the action of X-rays. Females in the later stages of pregnancy when given the proper dosage produce litters in which one or more of the young have serious eye defects, changes in the shape of the skull, and considerable retardation in growth in some instances. Nearly all such young prove to be sterile.

However, one female, treated in utero three days prior to its birth, showed marked eye defect of the right eye, skull small and somewhat abnormal in shape, general roughened appearance of the coat, and humping of the back-bone. This female was mated to a normal male and early produced a small litter which she was apparently unable to nurse, and as they were refused by foster mothers, died. At the present writing she has just thrown a litter of six young and is nursing them. As the eyes are unopened yet it is not known whether the defects have been transmitted. Several other such defective-eyed females are now half grown.

A brother of the female mentioned above had both eyes defective and paralysis of the hind limbs. His scrotum is of normal size, but the testes, by palpation, seem to be about the size of peas and are very hard nodules. He is completely sterile. Two other rats of this litter showed marked hemorrhage of the brain, and died soon after birth. This litter is typical of many.

134. Effects of alcohol fumes on three generations of albino rats. FRANK BLAIR HANSON.

Three generations of rats have been treated with alcohol fumes. The experiment began with two litters of twenty rats. Each litter was divided into control and treated groups. All matings are brother by sister within the litter. No eye defects or other gross abnormalities have been produced.

Treatment began at twenty days of age. Measurements of body weight, body length, and tail length were taken at ten day intervals. In the first two generations no apparent effects were produced except in fertility which is markedly lowered in the treated group. In the third generation there are quantitative differences between the treated and controls as follows:

1. *Body weight:* At twenty days the control male's mean weight was 27.22 ± 0.94; the treated 20.85 ± 0.49 grams. At the same age the control female's mean weight was 26.73 ± 1.13; the treated 21.60 ± 0.78. At 100 days the control males weighed 135.45 ± 7.51; the treated males 104.70 ± 3.60. At this age the control females had a mean weight of 130.00 ± 5.66; the treated females 79.00 ± 6.64.

2. *Litter size:* The mean litter size of the controls is 5.00 ± 0.47 animals per litter; of the treated 8.38 ± 0.44.

3. *Birth weight;* The mean birth weight of the controls was 6.55 ± 0.18 grams; of the treated 5.18 ± 0.05.

4. *Sex ratio:* The sex ratio of the controls was 48 males to 37 females, a percentage of 56.47 ± 3.63. In the treated it was 69 males to 40 females, a percentage of 63.30 ± 3.12.

The experiment is being continued.

135. Results of breeding potato beetles under changed environmental conditions. A. W. BELLAMY, University of Chicago.

One of thirteen pairs of beetles, all of which first deposited eggs in the greenhouse (control) and later, from eggs deposited under experimental conditions, gave an F_2 among which were one male and two females with broken elytral stripes. This character was kept through F_4.

Environmental factors condensed:

	Greenhouse (control)			Breeding Chamber		
	Max.	Min.	Average	Max.	Min.	Average
Temperature	38° C.	7	22	38.5	34.5	35.9
Rel. Humidity	100%	51	66	46	24	36
Rate of evap. cc. per hour	1.9	0.10	0.72	4.4	0.78	2.45

The entire stock of beetles is from one pair out of one of Prof. Tower's old stocks. Brother-sister matings were used throughout except for two matings, one in the fourth and one in the sixth generation, where a single male was mated to a female from nature (Urbana, Ill.). The experiment began in the seventh generation. Although several collateral lines produced a few broken stripe individuals in the third, fourth generations, no such individuals ever appeared in the direct line of descent, or elsewhere after the first out-cross, except those from the experiment. The material from which the Urbana females came was apparently free from the character. Collections on two successive years revealed no trace of it. The character *may* have been induced or "fixed" by the experimental conditions. It *may*

have been carried as a recessive although the out-crosses and brother-sister matings tend to lessen this possibility. Its appearance *may* have been coincident with the experiment. Attempts made in the third and fourth generations to "fix" the character were not successful.

136. Inheritance of weight in poultry. HENRY G. MAY, Rhode Island Agricultural Experiment Station.

Work begun by Dr. Philip Hadley at the Agricultural Experiment Station of Rhode Island State College and continued by the author since 1920 shows that after the first two months the White Cornish breed develops faster than the Silver Spangled Hamburgh breed. At nine months the two breeds average respectively 2200 and 1350 grams in case of the males and 1600 and 1050 in case of the females. In the Cornish males, growth is continued thereafter more slowly for seven months, when a further more rapid increase brings the weight at twenty-one monthsto about 3000 grams. In the Hamburgh males growth ceases at ten months and is resumed again at eighteen months, bringing the final weight at twenty-one months to 1750 grams. In the females growth ceases in both Cornish and Hamburghs at about ten months and is resumed again at eighteen months, producing a weight of 2400 and 1700 grams respectively at twenty-one months. All crossbred birds develop as rapidly as the Cornish or in some cases even more rapidly. They attain their maximum growth at eight to ten months, when they average slightly above the weight of the Cornish, thereafter they lose weight and do not again come up to the Cornish weight. At twenty-one months they are intermediate between Cornish and Hamburghs.

The crossbreds reared include first generation crosses in both directions and second generation crosses of three different types. The second generation crosses show no greater variability than do the Cornish or the first generation crosses.

137. A lethal type in mice, which may live for a few days after birth. (Lantern; 5 min.) J. A DETLEFSEN, The Wistar Institute.

In strains of black-eyed white mice a type of young has occurred rather frequently, which invariably dies one to three days after birth. Their appearance is distinctive and they can always be identified, since they are about one-half normal size and present a very white and bloodless appearance. Their occurrence suggests that the homozygous black-eyed white (which is lethal as in the case of homozygous yellow) may perhaps develop in some instances far beyond the stage supposedly characteristic of the homozygous yellow.

138. Linkage studies in mice. (Lantern; 5 min.) J. A DETLEFSEN and E. ROBERTS, The Wistar Institute and University of Illinois.

Crosses of dark-eyed black spotted waltzers with pink-eyed brown self-colored normals gave quadruple heterozygotes, which mated inter se produced 596 F_2 young. All four allelomorphic pairs proved to be independent. While the numbers are as large as in Darbishires cross, no evidence for the elimination of waltzers was found.

139. The heredity of the "white hooded" albino rat. DOROTHY R. STEWART. (Introduced by Frank Blair Hanson.)

In the course of some experiments with the albino rat it was evident that many of the animals were what we have called "white hooded albinos." When the "baby

fur' is shed —usually between the thirtieth and fiftieth days—it is by a process of differential shedding. The hair was lost first on the dorsal side in an area variable in extent, but corresponding in outline to the colored hooded pattern. The skin, showing through the thin hair, gives a pinkish cast to this region which persists until the new hair grows in. The hair on the rest of the body is shed while the new hair is appearing in the "hood," so that the pattern remains distinct for about two weeks. After that these rats are not distinguishable from ordinary albinos. Their breeding capacities are, however, quite different.

A white hooded albino female, answering the above description, when mated with a wild gray male gives all gray offspring. These, when crossed back with white hooded albinos, produce six classes of young: gray, black, gray hooded, and black hooded in apparently equal proportions, and also white hooded and pure albinos. Since a 1 : 1 ratio of gray and albino would ordinarily be expected of such a back cross, it would seem that our white hooded albinos carry the factor for self-coloration as a double recessive. Experiments are in progress to test the genetic constitution of these animals.

140. Recent studies on the relation of metabolism to sex. Oscar Riddle, Carnegie Station for Experimental Evolution.

The suprarenals of pigeons undergo marked hypertrophy coincident with each ovulation period. The enlargement persists over a total of 7 to 11 days. The reproductive overwork shown by Whitman and by the author to result in a changed sex ratio is therefore accompanied by an almost continuous change in this important metabolic organ. That the enlargement of the suprarenal medulla is accompanied by an increase of function has been fully demonstrated by a study of the blood sugar curve in relation to ovulation. The blood sugar value rises to 20 per cent above normal and its persistent high value clearly coincides with the period of suprarenal enlargement. These results hold for various species and hybrids.

That a low storage value (small size) of the ovum of the pigeon indicates a high rate of metabolism in such an ovum has been shown by measurements of the size of ova produced under the administration of glandular products whose action on the basal metabolism is definitely known. The secretion of the thyroid is known greatly to increase the metabolism and probably exercises this power not through intermediary mechanisms but directly by raising the oxidizing power of the cells. Ova produced under treatment with thyroid substance become markedly and consistently smaller. The thymus gland is known to exert no influence on the gaseous exchange; its administration has been shown to leave the storage metabolism of the ova unchanged. Studies with still other substances further confirm these results.

141. Further studies of the rate of mutation in the bar series of Drosophila. Charles Zeleny, University of Illinois.

The attempt to locate factors affecting the rate of mutation from bar to full has been unsuccessful so far but the existence of differences in rate has been demonstrated.

In the data previously presented before the society there were 52 mutants among 85,008 individuals, a rate of 61 per hundred thousand. One of two new series has essentially the same rate. The exact figures are 22 in 38,387 or a rate of 57 per hundred thousand. Another series however has a markedly lower rate with only

29 mutants among 104,019 individuals or 28 per hundred thousand. The difference is probably significant but the factors involved have not yet been analyzed.

Another interesting fact concerns the relative numbers of females and males among the mutants. In both of the new series the proportion is strikingly different from that of the old series. In the old series there were 31 females and 20 males while in New Series A there are 11 females and 18 males and in New Series B, 10 females and 12 males or a total for the two new series of 21 females and 30 males. It was concluded from the data of the old series, as reinforced by other considerations, that 31 females to 20 males indicates an approach to a two to one ratio which is to be expected on the assumption that female and male sex cells are equally subject to mutation. The data of the new series are obviously in conflict with this view.

142. The measurement of mutation frequency made practicable. H. J. Muller, University of Texas, Austin, Texas.

The method of measuring mutation frequency by counting the mutant genes accumulated in chromosomes protected from natural selection by balanced lethals (Muller, 1920) has various advantages over the separate testing of X-chromosomes each generation (Muller and Altenburg, 1919), but still involves excessive labor for (1) the several hundred crosses and selections establishing all the lines free from unknown mutant factors, (2) mere propagation of all cultures throughout the accumulation process, (3) the several hundred elaborate crosses for finally testing all lines,—some doubtful mutants, moreover, require further testing, of stocks derived from rare combinations; failure to obtain these may invalidate the entire experiment.

The following synthetic stocks overcome difficulties (1) and (3)

$$\text{"A"}: \quad \frac{T^d\, b\, c_n\, c\, a\, m_r}{C_y\, c_n^2\, C_{cR}}\ \frac{\Delta}{H}, \qquad \text{"B"}: \quad \frac{P}{C_y\, c_n^2\, C_{cR}}\ \frac{\Delta H T_r}{C_{III}\, l_{III}}.$$

To start the lines (1) merely place one A male and B females in each vial. All progeny are killed genetically except the required, self-perpetuating $\frac{T^d\, b\, c_n\, c\, a\, m_r}{C_y\, c_n^2\, C_{cR}}$.

In later generations, homozygous $T^d\, b\, c_n\, c\, a\, m_r$ (female sterile) also appear; provided no unknown lethal existed at the start; cultures having such homozygotes (easily identifiable through the bottle) absent or abnormal are discarded. For final tests (3) one male from each line, preferably A type, is crossed to B. Inspection of F_2 bottle reveals whether a new lethal has killed $T^d\, b\, c_n\, c\, a\, m_r$ homozygotes; all F_2 constitute stock for further testing.

The propagation difficulty (2) is overcome by embedding vials in concrete blocks, covered with cotton. For transferring, the flies are anaesthetized within the blocks, then uncovered, and shaken *en masse* into other blocks.

A new field of genetic research is thus opened up.

143. Sex-linked inheritance in the teleost Platypoecilus maculatus Günth. A. W. Bellamy, The University of Chicago.

In connection with other work on these and allied fishes some evidence has been obtained indicating that four color phases occurring in *Platypoecilus* ares ex-linked multiple allelomorphs, with the female the heterogametic sex. Nigra (N), rubra (R), and pulchra (P) are dominant to white (W). Probably any two of the four

characters will act as an allelomorphic pair although a number of crosses are not completed.

(1) A homozygous N♂ × W♀ gave in F_1, 9 N♂, 6 N♀ and in F_2, (2)—4 matings —98 N♂, 68 N♀, 65 W♀, 1 W♂. (3) F_2 N♂ × F_2 N♀ gave—3 matings— 32 N♂, 31 N♀. Another (4) gave 13 N♂, 6 N♀, 6 W♀. These data are in agreement with the hypothesis that (1) is NN × WO; (2) NW × NO; (3) NN × NO; (4) NW × NO. The remaining matings are given with the supposed gametic constitution. (5) RW × RO gave (2 matings) 30 RR and RW, 25 RO 12 WO. (6) RW × RO (father × F_1 daughter) gave RR and RW 28, RO 45, WO 31. (7) RW × NO gave RN 2, WN 5, RO 7, WO 4. (8) RN × WO from (7) gave NW and NO 11, RW and RO 13—fish too young to determine sex. (9) NN × RO gave NR 2, NO 2. (10) NR × NO from (9) gave NR 7 NN 4, NO 7, RO 6 and in addition there are 10 immature N, 6 immature R. The data for pulchra are similar to those given for rubra and nigra.

Four exceptions have occurred. 1 W♂ in (2) and 3 W♂ in a mating from (6), presumably RW × RO which gave 12 RR, and RW, 6 RO, 11 WO and *3 W♂*.

In the above formulae the "O" is used to designate the (supposedly) heterogametic female. Nothing is known concerning the chromosome relations. These data disagree in several important respects with the findings of Aida for *Aplocheilus latipes* (Genetics 6: 554-573) and Winge for *Lebestes reticulatus* (Jour. Genetics 12: 145–162).

144. Further control of sex in a species of Cladocera. Arthur M. Banta and L. A. Brown, Station for Experimental Evolution.

Experiments have demonstrated that the simple expedient of crowding the mothers causes the production of a considerable percentage of males among the offspring of several species of Cladocera.

This paper considers data for *Moina macrocopa*. Ten to 100 per cent males are produced in bottles containing 10 mothers while mothers in individual culture bottles (with rare exceptions) produce only females in first broods. It was found that the critical period, during which sex may be controlled by environmental influences, is near the close of the third instar, just before the eggs are laid. This is known to be, for certain Cladocera at least, the time at which the single maturation division gets under way.

The percentage of males produced by mothers reared in crowded bottles may be reduced by any of several methods of aeration. This suggested scarcity of oxygen or accumulation of carbon dioxide as possible factors involved in sex control. But in uncrowded bottles neither decreasing oxygen (by bubbling nitrogen), nor directly increasing the carbon dioxide, nor excluding air from the surface of the water induced the production of males.

Further work is being done on the supposition that the specific factor involved may be the accumulation of an excretory product, other than carbon dioxide.

The control of the production of the sexual egg is accomplished by crowding young mothers with reduced food or by crowding in old culture water.

145. A new mutation in Daphnia longispina and its inheritance. Arthur M. Banta, Station for Experimental Evolution.

This mutation is a conspicuous emargination or excavation of the normally almost

straight ventral head margin. It appeared in a single parthenogenetic individual, none of whose sisters possessed the character or produced young showing it.

"Excavated head" is inherited. All the descendants of the original mutant genetically possess the character, but it varies greatly in its somatic manifestation. Half or more than half the individuals show no morphological evidence of the character; a considerable percentage have it only slightly or moderately developed; and only a very few show the extreme development of the character, in which the entire ventral head region between the long slender beak and the eye is deeply excavated. All these classes of individuals,—the somatically 'normal,' 'slight,' 'intermediate,' and 'extreme' produce the excavated head in approximately the same percentages of their offspring. Further, the apparently normal mothers produce as high grade excavated heads as mothers showing extreme development of the character.

In spite of the peculiarities of its manifestation, excavated head behaves genetically quite as one would expect a character to behave in a parthenogenetic stock in which there is no segregation in the maturation of the egg.

LATE ABSTRACTS

On account of complications growing in the main, out of intersociety relations, the following abstracts were received too late to be included among those originally printed. They are given here in order to present a complete report of the proceedings of the meeting. The number preceding each abstract is the serial number which the title carries in the list of titles.

42. Notes on the entrance of the spermatozoon into the starfish egg. ROBERT CHAMBERS, Department of Anatomy, Cornell University Medical College, New York City.

Eggs in a sperm suspension apparently accelerate the movements of the spermatozoon without attracting them.

The glutinous jelly surrounding the eggs entraps the spermatozoa which accidentally strike it. As the spermatozoa are unable to pierce the jelly they remain stuck to its surface.

The presence of the spermatozoa causes the surface of the egg to produce nipple-like elevations. From the summit of each nipple a filament grows out through the jelly. Its tip fuses with the motionless head of a spermatozoon. It then retracts dragging the spermatozoon into the eggs.

The retraction of this filament is accompanied by the lifting of a membrane from the surface of the nipple. This membrane elevation spreads over the egg to produce the fertilization membrane. The retraction of the filament is also accompanied by a retraction of all other filaments. More than one filament may secure a spermatozoon, and polyspermy may then result. The breaking up of delayed filaments and the spread of the fertilization membrane assist in preventing polyspermy.

A certain minimum concentration of the sperm suspension is necessary to cause the egg to respond. This response is a function of the original egg cortex whether it be a fragment or entire. This explains the non-fertilizability of endoplasmic spheres.

The cortex of immature eggs behaves like that of mature eggs. The presence of neither the jelly nor of the egg membrane is necessary for fertilization.

43. The subdivisions of the neural folds in man. G. W. Bartelmez, The University of Chicago.

This analysis of the nervous system is based upon the recognition of certain landmarks: viz., 1) the otic segment which is distinctive in form, in the behavior of the neural crest arising from it and which is definitely related to other landmarks like the otic plate; 2) the midbrain which is located by the cranial flexure; 3) the first hindbrain segment, characterized by the behavior of its neural crest; 4) the first pair of somites.

In a two-somite embryo there are five enlargements of the neural folds: forebrain, midbrain, and three hindbrain segments. The first and last in the hindbrain subsequently divide, but the middle segment, the otic, remains distinct throughout the series and in the 4-mm. stage it is obviously the fourth rhombomere of the usual enumeration. One of the primary subdivisions of the folds is accordingly a definitive neuromere. The other subdivisions elongate and then neuromeres are separated from them. The differentiation thus evidenced begins caudally and proceeds forward. First the postotic ('rhombomere 5') and then the preotic ('rhombomere 3') appears; then the sixth and seventh are differentiated. Before this the first and second separate, but there is some doubt as to whether the 'first rhombomere' is a true neuromere. After the rhombomeres are formed the already pending division of the midbrain into two typical neuromeres is completed. Still later the primary forebrain divides.

86. Reactions of Hydra to chloretone. Wm. A. Kepner and D. L. Hopkins, University of Virginia.

In reacting to chloretone the ectoderm behaves as a neuromuscular tissue; while the endoderm functions as a neuroid tissue.

A sphincter has been observed at the base of each tentacle. This sphincter operates in preventing material from passing from the enteron into the tentacle, but does not prevent passage of material from the tentacle into the enteron.

There is no extensive diffusion of absorbed chloretone through the tissues of the body. A dibloblastic animal, therefore, cannot possess anything comparable to a circulatory medium.

Green hydras under ordinary conditions withstand the effects of chloretone much more than do brown and gray ones. Our experiments indicate that the presence of zoochlorellae of Hydra viridis is responsible for this hydra's resistance to chloretone, for we can greatly lower this resistance by placing the green hydras in the dark. This lends weight to the contention that the algae of green hydras endoderm are symbionts.

87. Blood and nerve as controlling agents in the movements of melanophores. Leland C. Wyman. (Introduced by G. H. Parker.)

By making a vertical incision through a part of the tail of a specimen of *Fundulus heteroclitus* L., the pigment motor nerves to the melanophores in the region posterior to the incision are severed and the distal portions of these nerves degenerate in a

few days. The blood supply to this region remains normal. The melanophores in the denervated area thus produced expand at first, but in four or five hours they partially contract, assuming a stellate form and remain in that condition until acted on by a direct stimulus. These denervated melanophores can be used as indicators to determine whether chemical substances introduced into the body of a fundulus at a point anterior to the incision have their action directly on the pigment cells being carried to them by the blood or have an indirect action through the nervous system. By this method it is found that a number of anesthetics and alkaloids when applied to the gills or injected into the body cavity cause various responses of the melanophores due to the action of the chemicals on some part of the nervous mechanism. Direct application of the same substances to the denervated melanophores causes similar responses, unless the chemical is one which rapidly coagulates the protoplasm of the cells. Alcohol, ergot, and several endocrin secretions, when applied to the animal in the same way, act directly on the melanophores, being carried to them in the blood. Salts have no indirect effect on melanophores. Although there is a close relation between the melanophores and the sympathetic nervous system, the cells can react normally when freed from nervous influences. Direct control by hormones or other chemical substances in the environment is an important adjunct to nervous control.

98. Caddisfly larvae of swift and standing waters. G. S. Dodds, West Virginia University, F. L. Hisaw, Kansas Agricultural College.

Forty-one species of caddisfly larvae from lakes and streams of the Rocky Mountains in Colorado form the basis of this study. These bodies of water range from stagnant ponds to the swiftest mountain torrents and have a rich population of mayfly nymphs and caddisfly larvae, both of which have been successful in populating almost all parts of both ponds and streams. Special attention is given to the problem of locomotion and retention of position in the swift streams. The caddisfly larvae, on account of the presence of the protective case, built by the insect itself, have, of necessity, met these conditions in a different way from the Mayfly nymphs and other animals without such a case. The present paper is an analysis of the habitats and types of cases found in each, and involves such points as habits of larvae, selection of materials, architectural instincts, difference in size, form and structure, and the species without cases.

99. An octo-flagellate parasitic in trout. Emmeline Moore, New York State Conservation Commission, E. S. A.

Octomitiasis is an intestinal disease of fish produced by the protozoan, Octomitus, an organism widespread in this country and endemic in many trout-rearing hatcheries. The infection is traceable to wild or domesticated fish which having survived the disease become carriers of the organism. Under conditions producing epidemics, the disease becomes rapidly fatal. Sexual and asexual cycles occur in the host with encystment stages in the epithelial tissue of the intestinal tract. Culture material gives important information in the life-history studies.

108. Induction of chromosomal mutants and their recognition in Datura. Albert F. Blakeslee and M. E. Farnham.

Balanced chromosomal types in Datura already known are 1n, 2n, 3n, 4n. Tetra-

ploid (4n) plants have been obtained in two ways:—*a*) from selecting, among 2n seeds, the rare 4n seeds recognized by their large size; *b*) from treating 2n parents with cold. Triploid (3n) offspring may be obtained by crossing a 4n with a 2n plant. The full range of (2n + 1) mutants may be expected from crossing a 3n with a 2n plant. Haploid (1n) plants have been induced by treating diploids (2n) with cold.

The balanced types are recognized by shape and size of leaves, flowers, capsules, etc.; their unbalanced types by the modifying effects of specific individual chromosomes. Pollen inspection is of aid in classifying balanced types in early stages. The even-balanced types 2n and 4n have relatively good pollen, but pollen grains of 4n plants is distinctly larger. The odd-balanced types 1n and 3n have a high percentage of bad grains; the few full grains from 1n plants are of the size of normal grains in diploids (2n), whereas the full grains from 3n plants show a great diversity in size.

109. Induction of gene and chromosome mutations in Datura by exposure to radium rays. C. Stuart Gager and A. F. Blakeslee.

Ovaries in young flower buds of Datura stramonium of stock inbred for about twelve generations were exposed to rays from radium emanation in a sealed glass tube, strength 13 microcuries, for ten minutes. This treatment was followed by a great increase in number of mutants, with maximum of 33.33 per cent for ovary cell nearest radium, 11.54 per cent for cell farthest away, and average of 16.96 per cent for all four cells. Average percentage of mutants in same stock for four years (1919–1922) was 1.38, with maximum in one case (1920) of 7.07 per cent, due possibly to low temperature of late fall.

110. The distribution of chromosomes in tetraploid daturas. J. Belling and A. F. Blakeslee, Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York.

Six size classes of chromosomes recognizable at all stages. Attraction of homologous chromosomes produces quadrivalents. Non-disjunction, leading to the formation of 23- and 25-chromosome pollen, occurs in from a quarter to a third of the reduction divisions. Some 47- and 49-chromosome progeny therefore occurs. Double opposed non-disjunction produces plants with 48 chromosomes, having ten quadrivalents, one trivalent, and one quinquevalent. Their progeny shows many 47- and 49-chromosome plants. Detachment of chromosomes. Non-reduction. Chromosomes of functional egg cells shown in cross of tetraploid by diploid. Tetraploid inheritance. Plants with a reduction or deficient chromosome produced by the cross of triploid by tetraploid. Twenty-four-chromosome pollen in diploid plants. Conclusion.

112. Ratios of globe mutants to normal plants in Datura after pollination with counted pollen. J. T. Buchholz, and A. F. Blakeslee.

Small amounts of pollen from globes and normal plants were counted and applied to the stigmas of both globes and normal daturas. The results obtained from these, compared with controls, indicates that the resulting small capsules contain on an average a much smaller proportion of globes than the well-pollinated large ones. In the smaller seed capsules, the proportion of aborted ovules found scattered among the

seeds is greater than in large capsules, and it is nearly always much greater in the lower half of any capsule than in the upper half. In globe × normal crosses, both in full pollinations and in restricted pollinations, the lower half of the seed capsules usually contained a much smaller proportion of globes than the upper half. This difference was not so great and more irregular in globes than were sibbed or selfed. Any increase which may have been obtained in the number of $(n + 1)$ pollen tubes entering the ovary in the restricted pollinations was more than offset by the selective elimination among the ovules of the smaller seed capsules. That the $(n + 1)$ pollen tubes growing more slowly than those with n chromosomes is indicated by the fact that with only one exception there are more globes in the lower half than in the upper of the capsules from the normal × globe crosses; also the only $(2n + 2)$ globes obtained were from the lower half of the globe × globe capsules. Data are from eight or more capsules in each cross.

113. Species in the genus Rubus and Crataegus. ALBERT E. LONGLEY.

Interested in the problems centered around imperfect pollen, I collected in the spring of 1921 flower buds of many species of Rubus and Crataegus. This material I have studied carefully in regard to the development of the pollen tetrad.

Recent work of Taeckholm and others on the genus Rosa, led to the apparently well-founded conclusions that many of the species in this genus are of hybrid origin.

I have come to a like result regarding many species of Rubus and Crataegus, based on the following phenomena, which one recognizes as characteristic of pollen development in hybrids.

1. Polyploidy, which is present in three-quarters of the Rubi examined.
2. Irregularities in the heterotypic and homotypic divisions, e.g., chromosomes that are tardy in arriving at, and leaving the plate.
3. The presence of ejected chromatin material in the cytoplasm, resulting from chromosomes failing to be included in the daughter nuclei.
4. The presence of dwarf nuclei, derived from chromosomes left in the cytoplasm.
5. Multinucleated pollen grains, due to the presence of dwarf nuclei.

114. On a gigantic natural hybrid of the silverweed (Potentilla anserina). E. C. JEFFREY.

The true silverweed, *Potentilla anserina*, s. str., occurs in salt marshes. A variety of it growing at the head of beaches and in grassy spots not much permeated by sodium chloride is known to systematic botanists as *Potentilla anserina*, var. *grandis*. The author has observed that this variety of silverweed is extremely sterile, only in the rarest instances setting any seed at all, and these always few in number. The pollen grains are largely aborted, and in this feature present a marked contrast to the true *P. anserina*. The cytology of the development of the gonads furnishes conclusive evidence of the hybrid character of this gigantic form of the silver-weed.

115. On the origin of the Boston fern. E. C. JEFFREY.

From the investigation of a large number of varieties of the Boston fern, as well as the original type, the conclusion is reached that this popular horticultural monstrosity is a hybrid. The cytological investigation has shown that the sporogeny of the Boston fern is strikingly unlike that of other and normal species of Nephrolepis

grown in the same greenhouse, and very similar to that of interspecific and bigeneric hybrid ferns. The conclusion is reached that the Boston fern is a hybrid, and consequently cannot be used as an example of mutation.

116. Further evidence of crossing over in Oenothera. GEORGE H. SHULL.

Notwithstanding the fact that students of Oenothera cytology find no situation which seems favorable to the occurrence of crossing over by the chiasmatype method generally advocated by the Drosophila students, the genetical evidence for the occurrence of crossing over in the Oenotheras is unequivocal.

Crossover data are here presented for (a) revolute leaves and red hypanthia (less than one per cent); (b) revolute leaves and red stems (2.45 to 3.08 per cent); (c) red hypanthia and sulfur colored flowers (6.1 to 8.7 per cent); and (d) sulfur-colored flowers and dwarfness (4.7 and 9.2 per cent). In some of the crosses the action of the two sets of balanced lethals,—the gamete lethals and the zygote lethals—are clearly manifested, and there is also some distortions of ratios by differential elimination. In one case there is an apparent release from the typical linkage relation, so that a typical dihybrid ratio is presented.

117. A preliminary account of the genetics of Clarkia elegans. L. L. BURLINGAME.

This paper describes the inheritance and factorial basis of the following color types: white, cerise, magenta, lilac, lavender and salmon pink. Two striking form variations of the plants are also described. Cerise and magenta are, respectively, due to a single mutation in two separate chromosome pairs. The double recessive is white and the double dominant is lilac. Lavender is due to a dominant mutation in the same chromosome as the magenta factor and is accordingly linked with cerise from which it crosses over in about 20 per cent of the gametes. A twining habit and a conspicuous open habit of growth are both recessive to the normal upright richly branched habit.

146. The translocation of a section of chromosome-II upon chromosome-III in Drosophila. C. B. BRIDGES, Carnegie Institution of Washington and Columbia University. (Introduced by T. H. Morgan.)

A mutant eye-color, Pale, was found to be a non-sex-linked specific modifier of eosin without effect by itself. Pale is a dominant with special relation to viability. A Pale by Star Dichaete male back-cross showed that Pale is produced by (besides eosin) a second-chromosome dominant (PII) and a third-chromosome dominant (PIII). In heterozygous condition PII is a zygotic lethal unless PIII is also present. In homozygous condition PII is lethal even when PIII is present. Heterozygous PIII is slightly below par in viability when PII is not present, but has normal viability when PII is present in heterozygous form. PIII is completely lethal when homozygous, unless PII is present in heterozygous form, in which case it is viable, but below par.

Crossing-over experiments show that the location of PII is the entire section, of some eight units' length, from arc to the right end of the second-chromosome, throughout which region crossing-over is entirely suppressed. PIII is located to the left of rough and suppresses nearly all the crossing-over in the adjacent region,

viz., from spineless to the right end of chromosome-III. When Piii is present, all the recessive mutants (viz., plexus, brown, speck, morulla, balloon, blistered, purpleoid, and lethal-IIa) whose loci lie to the right of arc in chromosome-II fail to show as characters even when homozygous.

The above situation (with other factors not referred to) led to the interpretation that Piii is a broken-off end of the second-chromosome, and that Pii is the second chromosome from which this end has been broken.

AMERICAN SOCIETY OF ZOÖLOGISTS

CONSTITUTION, OFFICERS AND LIST OF MEMBERS OF THE SOCIETY

CONSTITUTION

Article I

NAME AND OBJECT

Section 1. The Society shall be called the "American Society of Zoölogists."

Sec. 2. The object of the Society shall be the association of workers in the field of Zoölogy for the presentation and discussion of new or important facts and problems in that science and for the adoption of such measures as shall tend to the advancement of zoölogical investigation in this country.

Article II

MEMBERSHIP

Section 1. Members of the Society shall be elected from persons who are active workers in the field of Zoölogy and who have contributed to the advancement of that science.

Zoologists without the training in research required for full membership may be elected associate members of the Society.

Sec. 2. Election to membership in the Society shall be upon recommendation of the Executive Committee.

Sec. 3. Each member shall pay to the Treasurer an annual assessment as determined by the Society. This assessment shall be considered due at the annual meeting and the name of any member two years in arrears for annual assessments shall be erased from the list of members of the Society, and no such person shall be restored to membership unless his arrearages shall have been paid or he shall have been re-elected.

Sec. 4. Foreign Zoölogists, not members of this Society, may be elected Honorary Fellows upon unanimous recommendation of the Executive Committee by a majority vote of the members present at any meeting of the Society. Honorary Fellows shall not be required to pay dues.

Article III

OFFICERS

Section 1. The officers of the Society shall be a President, a Vice-President, a Secretary and a Treasurer and the members at large of the Executive Committee.

Sec. 2. The Executive Committee shall consist of the President, the Vice President, the Secretary, the Treasurer and five members elected from the Society at

large. Of these five members, one shall be elected each year to serve five years. If any member at large shall be elected to any other office, a member at large shall be elected at once to serve out the remainder of his term.

Sec. 3. These officers shall be elected by ballot at the annual meeting of the Society and their official terms shall commence with the close of the annual meeting, except that the Secretary and the Treasurer shall be elected triennially and shall serve for three years.

Sec. 4. The officers named in Section 1 shall discharge the duties usually assigned to their respective offices.

Sec. 5. Vacancies in the board of officers, occurring from any cause, may be filled by election by ballot at any meeting of the Society. A vacancy in either the Secretaryship or the Treasurership occurring in the interval of the meetings of the Society may be filled by appointment, until the next annual meeting, by the Executive Committee.

Sec. 6. At the annual meeting the President shall name a nominating committee of three members. This committee shall make its nominations to the Secretary not less than one month before the next annual meeting. It shall be the duty of the Secretary to mail the list of nominations to all members of the Society at least two weeks before the annual meeting. Additional nominations for any office may be made in writing to the Secretary by any five members at any time previous to balloting.

Article IV

MEETINGS OF THE SOCIETY

Section 1. Unless previously determined by the Society the time and place of the annual meeting of the Society shall be determined by its Executive Committee. Special meetings may be called and arranged for by the Executive Committee. Notices of such meetings shall be mailed to all members of the Society at least two weeks before the date set for the meeting.

Sec. 2. Sections of the Society may be organized in any locality by not less than ten members, for the purpose of holding meetings for the presentation of scientific papers. Such sections shall have the right to elect their own officers and also associate members; provided, however, that associate membership in any section shall not confer membership in the Society.

Article V

QUORUM

Twenty-five members shall constitute a quorum of the Society and four a quorum of its Executive Committee.

Article VI

CHANGES IN THE CONSTITUTION

Amendments to this Constitution may be adopted at any meeting of the Society by a two-thirds vote of the members present, upon the following conditions:

(a) The proposed amendment must be in writing and signed by at least five members of the Society.

(b) This signed proposal must be in the hands of the Secretary at least one month before the meeting of the Society at which it is to be considered.

(c) The Secretary shall mail copies of the proposed amendment to the members of the Society at least two weeks before the meeting.

BY-LAWS

DUES

(1) The annual dues for members or associate members, unless remitted or changed by the vote of the Society, shall be seven dollars.

SECRETARY

(2) The duties and privileges of the Secretary shall be as follows:

(a) He shall keep the records of the Society.

(b) Whenever the proper officers of a number of related societies shall have a conference with a view to determining a common time and place for the several annual meetings, he shall act as the delegate or representative of this Society. (See also 5.)

(c) He shall employ a typewriter or printer whenever in his judgment such employment will expedite the business of the Society, and

(d) He shall be reimbursed out of the funds of the Society for expenses incurred in attending meetings of the Society.

TREASURER

(3) The duties and privileges of the Treasurer shall be as follows:

(a) He shall be in charge of the funds of the Society.

(b) At the Annual Business Meeting of the Society he shall present a statement to date of the funds of the Society.

(c) He shall employ a typewriter or printer whenever in his judgment such employment will expedite the business of the Society.

AUDITING COMMITTEE

(4) The President shall annually appoint an auditing committee of two, who shall audit and report upon the financial record and statement of the Treasurer at the meeting for which they were appointed.

(5) The National Research Council allows the Society three representatives on the Division of Biology and Agriculture. Of these three representatives, one shall be elected each year to serve three years. The method of election shall be the same as that used in the election of the officers of the Society.

MEETINGS

(6) It shall be the policy of the Society to hold meetings in both Eastern and Central-Western territory, and the distribution of the meetings between the two territories shall be determined in general on the basis of the representation of Eastern and Western members in the Society. See also 2-b.

PROGRAM RULES

(7) In matters relating to programs for annual meetings the following rules shall be observed:

(a) Papers shall be listed and presented according to subject matter in the following groups: 1. Comparative Anatomy; 2. Embryology; 3. Cytology; 4. Genetics; 5. Comparative and General Physiology; 6. Ecology, and 7. Miscellaneous, or other groups at the discretion of the Secretary.

(b) Whenever conditions require it the Executive Committee shall schedule two or more groups for the same hour and rearrange the program to bring together papers on subjects of more general interest for meetings of the whole Society. The Committee, however, is instructed to avoid conflicts as much as possible.

(c) Papers shall be listed in their respective groups in the order received. When a member offers more than one paper those following the one designated first shall be placed at the end of the list and shall not be read until all first papers by members shall have been twice called for.

(d) All papers not read when called for as listed shall be placed at the end of the group list, and, if not read when called for the second time, they shall be read by title only.

(e) The titles of "introduced" papers shall be listed in the groups after the titles of papers to be read by members. Such papers shall be read by title only in case the entire program cannot be completed during four regular sessions for reading papers.

(f) Fifteen minutes shall be the maximum time allowed for the presentation of a paper.

(g) Abstracts of papers for publication in the proceedings of the Society must be handed to the Secretary or his representative before final adjournment of the annual meeting.

(8) Associate members may become members of sections of the Society and are entitled to the journal privileges of members.

HISTORICAL REVIEW

A review of the historical antecedents of the present American Society of Zoölogists will be found in *The Anatomical Record* for January, 1917. The list of officers and meeting places of the present Society found in the same place is brought up to date and reprinted here.

LIST OF FORMER OFFICERS

American Morphological Society

President	*Vice-President*	*Secretary-Treasurer*
1890—E. B. Wilson	.....	J. P. McMurrich
1891—C. O. Whitman	E. L. Mark	J. P. McMurrich
1892—C. O. Whitman	H. F. Osborn	J. P. McMurrich
1893—C. O. Whitman	E. B. Wilson	J. P. McMurrich
1894—C. O. Whitman	W. B. Scott	G. H. Parker
1895—E. B. Wilson	W. B. Scott	G. H. Parker
1896—E. L. Mark	H. F. Osborn	G. H. Parker
1897—C. S. Minot	S. I. Smith	G. H. Parker
1898—H. F. Osborn	T. H. Morgan	G. H. Parker
1899—E. G. Conklin	W. M. Wheeler	Bashford Dean
1900—T. H. Morgan	H. C. Bumpus	J. S. Kingsley
1901—J. S. Kingsley	E. A. Andrews	T. H. Montgomery
1902—H. C. Bumpus	G. H. Parker	M. M. Metcalf

Additional Members of the Executive Committee

1891—E. B. Wilson
H. F. Osborn
1892—E. L. Mark
T. H. Morgan
1893—T. H. Morgan
C. B. Davenport
1894—E. A. Andrews
F. H. Herrick
1895—T. H. Morgan
S. Watase
1896—E. G. Conklin
William Patten
1897—J. S. Kingsley
Bashford Dean
1898—C. B. Davenport
F. R. Lillie
1899—J. P. McMurrich
G. H. Parker
1900—F. R. Lillie
Jacob Reighard
1901—C. F. W. McClure
C. W. Hargitt
1902—H. S. Jennings
R. G. Harrison

American Society of Zoölogists

EASTERN BRANCH	*President*	CENTRAL BRANCH
G. H. Parker	1903	Jacob Reighard
E. A. Andrews	1904	C. H. Eigenmann
W. E. Castle	1905	F. R. Lillie
W. E. Castle	1906	C. C. Nutting
C. B. Davenport	1907	S. A. Forbes
W. M. Wheeler	1908	E. A. Birge
H. S. Jennings	1909	E. A. Birge
T. H. Montgomery	1910	C. E. McClung
H. V. Wilson	1911	George Lefevre
A. G. Mayer	1912	H. B. Ward
Raymond Pearl	1913	H. B. Ward

LIST OF FORMER OFFICERS

EASTERN BRANCH	*Vice-President*	CENTRAL BRANCH
Jacob Reighard	1903	H. F. Nachtrieb
W. E. Castle	1904	S. J. Holmes
William Patten	1905	William A. Locy
William Patten	1906	George Lefevre
F. H. Herrick	1907	H. B. Ward
H. S. Jennings	1908	M. F. Guyer
H. V. Wilson	1909	M. F. Guyer
H. H. Wilder	1910	H. F. Nachtrieb
H. E. Crampton	1911	R. H. Walcott
G. A. Drew	1912	C. M. Child
Alex. Petrunkevitch	1913	C. M. Child
	Secretary-Treasurer	
G. A. Drew	1903	Frank Smith
G. A. Drew	1904	F. R. Lillie
H. S. Pratt	1905	C. E. McClung
H. S. Pratt	1906	T. G. Lee
C. J. Herrick	1907	T. G. Lee
L. L. Woodruff	1908	T. G. Lee
L. L. Woodruff	1909	Charles Zeleny
H. W. Rand	1910	H. V. Neal
Raymond Pearl	1911	H. V. Neal
J. H. Gerould	1912	W. C. Curtis
Caswell Grave	1913	W. C. Curtis

Executive Committemen:

F. R. Lillie	George Lefevre
T. H. Montgomery	T. G. Lee
H. C. Bumpus	Herbert Osborn
H. S. Jennings	C. H. Eigenmann
E. A. Andrews	J. G. Needham
W. R. Coe	S. J. Holmes
G. A. Drew	W. A. Locy
M. M. Metcalf	C. M. Child
D. H. Tennent	R. H. Walcott
R. G. Harrison	W. C. Curtis
H. E. Jordan	Oscar Riddle
C. E. McClung	H. B. Ward
	Chauncey Juday
	H. W. Norris
	C. E. McClung
	H. F. Nachtrieb

AMERICAN SOCIETY OF ZOÖLOGISTS (AMALGAMATED)

	President	*Vice-President*	*Executive Committeemen*
1914.	C. E. McClung	M. F. Guyer	H. E. Jordan—1 year H. F. Nachtrieb—2 years H. V. Wilson—3 years George Lefevre—4 years A. F. Shull—5 years
1915.	W. A. Locy	W. E. Ritter	D. H. Tennent
1916.	D. H. Tennent	Charles Zeleny	R. P. Bigelow—5 years L. J. Cole—4 years
1917.	M. M. Metcalf	Charles Zeleny	H. V. Wilson
1918.	George Lefevre	L. L. Woodruff	M. M. Metcalf
1919.	C. M. Child	H. H. Wilder	George Lefevre
1920.	Gilman A. Drew	Caswell Grave	C. M. Child
1921.	Charles A. Kofoid	Aaron L. Treadwell	G. A. Drew
1922.	H. H. Wilder	Bennet M. Allen	C. A. Kofoid

Secretary-Treasurer

1914–1918. Caswell Grave
1918–1921. W. C. Allee

Secretary	*Treasurer*
1921. W. C. Allee	1921. D. H. Tennent

Representative in the Division of Biology and Agriculture, National Research Council

M. F. Guyer 1919–1921 G. H. Parker 1919–1922 F. R. Lillie 1919–1923

Associate Editors of the Journal of Morphology

1921

Gary N. Calkins J. S. Kingsley William Patten

1921–22

E. G. Conklin M. F. Guyer W. M. Wheeler

LIST OF PLACES OF MEETING

AMERICAN MORPHOLOGICAL SOCIETY

1890—Boston	1894—Baltimore	1899—New Haven
1891—Philadelphia	1895—Philadelphia	1900—Baltimore
1892—Princeton	1896—Boston	1901—Chicago
1893—New Haven	1897—Ithaca	1902—Washington
	1898—New York	

CENTRAL NATURALISTS

1899—Chicago 1900—Chicago

SOCIETY OF AMERICAN ZOÖLOGISTS

1901—Chicago 1902—Washington

AMERICAN SOCIETY OF ZOÖLOGISTS

EASTERN BRANCH	JOINT MEETINGS	CENTRAL BRANCH
1903—Philadelphia	1905—Ann Arbor	1903—St. Louis
1904—Philadelphia	1908—Baltimore	1905—(Mch.) Chicago
1906—New York	1911—Princcton	1907—(Mch.) Madison
1907—New Haven	1912—Cleveland	1907—Chicago
1909—Boston	1913—Philadelphia	1910—(Apr.)Iowa City
1910—Ithaca		1910—Minneapolis
		1912—(Apr.) Urbana

MEETING PLACES

1914—Philadelphia	1917—Minneapolis	1920—Chicago
1915—Columbus	1918—Baltimore	1921—Toronto
1916—New York	1919—St. Louis	1922—Boston

AMERICAN SOCIETY OF ZOÖLOGISTS

OFFICERS AND LIST OF MEMBERS[1]

Officers for 1923

President ..... M. F. Guyer
Vice-President ..... R. A. Budington
Secretary ..... W. C. Allee
Treasurer ..... D. H. Tennent

Executive Committee

George Lefevre 1923
C. M. Child 1924
Gilman A. Drew 1925
Charles A. Kofoid 1926
H. H. Wilder 1927

Representatives of the Society in the Division of Biology and Agriculture of the National Research Council

F. R. Lillie 1923
H. S. Jennings 1924
E. G. Conklin 1925

EDITORIAL BOARD OF THE JOURNAL OF MORPHOLOGY

Managing Editor (term expires 1926) ..... C. E. McClung

Associate Editors

To serve until 1924 ..... C. A. Kofoid, F. R. Lillie, J. T. Patterson
To serve until 1925 ..... G. A. Drew, H. V. Neal, L. L. Woodruff
To serve until 1926 ..... Caswell Grave, D. H. Tennent, H. V. Wilson

[1] The data given in this list is based on the last preceding list published in *The Anatomical Record*, Vol. 23, No. 1, with such corrections and additions as have come to the attention of the Secretary Please notify the Secretary of errors in this copy of the membership list that they may be corrected in the next published list.

HONORARY FELLOW

BATESON, WILLIAM, The John Innes Horticultural Institution, The Manor House, Merten, S. W. 19, England.

LIFE MEMBERS

ANDREWS, ETHAN ALLEN, Ph.B. (Yale), Ph.D. (Johns Hopkins), Professor of Zoölogy, *Johns Hopkins University, Baltimore, Md.*

DEAN, BASHFORD, A.B. (College of City of New York), A.M., Ph.D. (Columbia), Professor of Vertebrate Zoölogy, Columbia University; Curator Emeritus of Fishes and Reptiles, *American Museum Natural History, Riverdale-on-Hudson, New York.*

HENSHAW, SAMUEL, Director of Museum of Comparative Zoölogy, *8 Fayerweather Street, Cambridge, Mass.*

METCALF, MAYNARD MAYO, A.B., Sc.D. (Oberlin), Ph.D. (Johns Hopkins), Orchard Laboratory, *128 Forest Street, Oberlin, Ohio.*

MOORE, J. PERCY, Ph.D. (Pennsylvania), Professor of Zoölogy, *University of Pennsylvania, Philadelphia, Pa.*

STILES, CHARLES W., A.M., Ph.D. (Leipzig) S.M., S.D. (Wesleyan), Professor of Zoölogy, United States Public Health and Marine Hospital Service, Hygienic Laboratory. *Twenty-fifth and E. Streets, N.W., Washington, D. C.* (October 1–May 1); *Wilmington, N. C.* (May–October 1).

MEMBERS

ACKERT, JAMES EDWARD, A.B., A.M., Ph.D. (University of Illinois), Professor of Zoölogy, Parasitologist Agr. Exp. Station; *Kansas State Agricultural College, Manhattan, Kan.*

ADOLPH, EDWARD FREDERICK, A.B., Ph.D. (Harvard), Instructor in General Physiology, University of Pittsburgh, *Biology Hall, University of Pittsburgh, Pittsburgh, Pa.*

AGERSBORG, HELMAR PARELI VON WOLD KJERSCHOW, S.B., S.M. (Washington), A.M. (Columbia), Instructor in Zoölogy, *University of Nebraska, Lincoln, Nebraska.*

ALEXANDER, CHARLES PAUL, B.S., Ph.D. (Cornell), Systematic Entomologist for the State Natural History Survey of Illinois, *Natural History Bldg., 316 A, Urbana, Illinois.*

ALLEE, WARDER CLYDE, S.B. (Earlham College), S.M., Ph.D. (Chicago), Assistant Professor of Zoölogy, *University of Chicago, Chicago, Ill.*

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ALLEN, WILLIAM RAY, A.B., A.M., Ph.D. (Indiana), Kentucky State University, Lexington, Ky.

AREY, LESLIE BRAINERD, Ph.D. (Harvard), Professor of Microscopic Anatomy, *Northwestern University Medical School, 2431 Dearborn St., Chicago, Ill.*

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BAKER, ARTHUR CHALLEN, B.S.A. (Toronto University), Ph.D. (George Washington University), Entomologist, Fruit Insect Investigations, *U. S. Bureau of Entomology, Washington, D. C.*

BAKER, HORACE BARRINGTON, B.S., Ph.D. (Michigan), Instructor of Zoölogy, University of Pennsylvania, *Zoölogical Laboratory, University of Pennsylvania, Philadelphia, Pa.*

BANTA, ARTHUR MANGUN, A.B., A.M. (Indiana), Ph.D. (Harvard), Resident Investigator, *Station for Experimental Evolution, Carnegie Institution, Cold Spring Harbor, Long Island, N. Y.*

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BARROWS, WILLIAM MORTON, B.S. (Michigan Agricultural College), S.B., S.M., S.D. (Harvard), Department of Zoölogy and Entomology, *Ohio State University, Columbus, Ohio.*

BARTELMEZ, GEORGE W., Ph.D. (Chicago), Associate Professor of Anatomy, *University of Chicago, Chicago, Ill.*

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Budington, Robert Allyn, B.A., M.A. (Williams), Professor of Zoölogy, *Oberlin College, Oberlin, Ohio.*

Burrows, Montrose T., A.B. (Kansas), M.D. (John Hopkins), Associate Professor Exp. Surgery, Director of Research Laboratories, Barnard Free Skin and Cancer Hospital, *Washington University Medical School, St. Louis, Mo.*

Byrnes, Esther F., Ph.D. (Bryn Mawr), *193 Jefferson Avenue, Brooklyn, N. Y.*

Calkins, Gary N., B.S. (Mass. Inst. Tech.), Ph.D. (Columbia), Professor of Protozoölogy, *Columbia University, New York City.*

Calvert, Philip Powell, Ph.D. (Pennsylvania), Professor of Zoölogy, *University of Pennsylvania, Zoölogical Laboratory, Philadelphia, Pa.*

Cameron, Alfred Ernest, M.A., D.Sc. (Aberdeen, Scot.), M.Sc. (Manchester, Eng.), Professor of Zoölogy, University of Saskatchewan, *616, Lansdowne Avenue, Saskatoon, Sask.*

Carothers, E. Eleanor, A.B., A.M., Ph.D., *Zoölogical Building, University of Pennsylvania, Philadelphia, Pa.*

Carpenter, Frederic Walton, B.S. (New York University), A.M. Ph.D. (Harvard), Professor of Biology, *Trinity College, Hartford, Conn.*

Casteel, Dana Brackenridge, A.B. (Allegheny), A.M. (Ohio Wesleyan), Ph.D. (University of Pennsylvania), Professor of Zoölogy, *University of Texas, Austin, Texas.*

Castle, William E., A.B. (Denison), A.M., Ph.D. (Harvard), Professor of Zoölogy in Harvard University, *186 Payson Road, Belmont, Mass.*

Chambers, Robert, Jr., M.A. (Queen's University, Can.), Ph.D. (Munich), Assistant Professor in Anatomy, *Cornell University Medical College, 28th Street and First Avenue, New York City.*

Chapman, Royal N., B.A., M.A. (Minnesota), Ph.D. (Cornell), Assistant Professor of Animal Biology; Assistant Entomologist, Experiment Station, University of Minnesota; *305 Animal Biology, University of Minnesota, Minneapolis, Minn.*

Chester, Wayland Morgan, A.B., A.M. (Colgate University), Professor of Biology, *Colgate University, Hamilton, N. Y.*

Chidester, Floyd Earle, Ph.B. (Syracuse), Ph.D. (Clark), Associate Professor of Zoölogy, *West Virginia University, Morgantown, W. Va.*

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